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Necessitation of zinc supplementation to ruminants

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Animals are provided balanced ration to achieve optimum productivity. Among the various nutrients provided to animals, minerals hold the key importance. Minerals are broadly divided into macrominerals and microminerals as per the animal requirements. Zinc is one of the most important micromineral as it is practically required for almost every function of the body. Zinc supplementation has become the norm in the present production system. The reasons which made zinc supplementation inevitable in the animal ration are reviewed here. Zinc supplementation to ruminants should be encouraged at least for three reasons. Firstly, Indian soils in general are deficit in the mineral and due to high soil pH even external application of zinc is not useful. Secondly, zinc is relatively non-toxic mineral and doesn't show any serious toxic signs even at very high supplementation. Finally, zinc has proven therapeutic properties.

ZINC DEFICIENCY IN INDIAN SOILS

Concentration of micronutrients in the soil is a function of many geological processes; however, the availability of microminerals depends upon several physical, chemical and biological factors like soil pH, absorptive surface, organic carbon and clay content. Zinc is among one of the minerals whose deficiency in the soils is reported across the India, particularly in the states where the practice of multiple cropping is quite common (Figure 1). Zinc deficiency occurs primarily on account of intensive cropping of high yielding varieties of forages in these states. In a systematic survey, an analysis of 5,673 soil samples revealed that deficiency of Zn in the soils of Haryana is around 15.3% (1.1% to 36.5%). The annual consumption of zinc sulphate as a fertilizer in the Haryana state is reported to be 14,651 tonnes making it third largest zinc sulphate user state after Punjab and Andhra Pradesh. However, in some conditions like high soil pH, the

availability of zinc to the plants decreases resulting in the lower plant zinc content, not enough to meet the animal requirements. Aliarabi (2005), reported the average zinc content of wheat straw, paddy straw, berseem, oats, jowar and maize collected from various places of Haryana to be 17.08, 16.74, 36.56, 32.61, 17.35 and 18.18 ppm respectively. While the levels of Zn reported by Maan *et al.* (2003), for wheat straw, berseem, oats, *Phalaris minor*, cottonseed, cottonseed cake, wheat and rapeseed meal cake were 22.6, 23.1, 22.9, 8.6, 42.8, 51.1, 37.9 and 50.3 ppm, respectively. Most of these values are below the critical level of 40 ppm. A positive relationship between soil Zn content, Zn content of forages and fodders and animal Zn status have been clearly established. Yadav *et al.* (2000) successfully traced the low zinc concentration of milk to be an outcome of low Zn levels in local soils and fodder produced by these soils. Similarly, zinc status of buffaloes in Haryana indicates that 14% of them have serum zinc concentration below critical level and most of them have deficit zinc content in hair and milk. Moreover, zinc availability to the animals through forage diet is not very good. Therefore, even if a forage analysis shows adequate levels of zinc, subclinical deficiencies do occur. Thus, supplementation of zinc to the animals is inevitable and should be a part of well defined feeding regime.

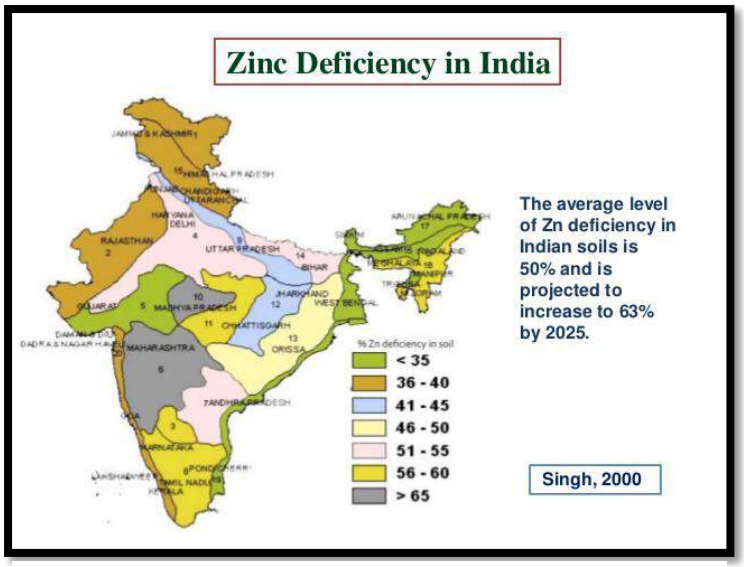

Figure 1: Zinc deficiency map of India

SUPPLEMENTATION OF ZINC

Dietary supplementation of zinc from various sources to animals has proven to be beneficial. It enhances the production performance, health and reproduction of ruminants. Supplementation of zinc above the requirement level considerably increases the growth rate of all classes of animals including pigs, steers, growing heifers, feedlot lambs, rats and guinea pigs. Zinc affects the somatotrophic axis at multiple levels and has well defined regulation mechanism in the transcription of growth hormone gene. Zinc supplementation tends to increase the total blood protein, albumin, and serum

alkaline phosphatase activity in guinea pigs (Shinde *et al.,* 2006). However, concentrations of glucose, total protein, albumin, globulin, urea, uric acid, and creatinine and the level of various serum enzymes viz. lactate dehydrogenase, alkaline phosphatase, glutamate pyruvate transaminase, glutamate oxaloacetate transaminase and hormones viz. T3, T4, testosterone and insulin doesn't change upon supplementation of 40ppm zinc in male Buffalo (*Bubalus bubalis*) calves maintained on basal diet. Animals on high quality diets didn't show any change in the ruminal ammonia and total VFA concentrations upon supplemtation of Zn. However, its supplementation did change the proportion of individual VFA's as the proportion of propionate tend to increase, and the proportion of butyrate tend to decrease with dietary Zn supplementation. This indicates that supplemental Zn is ineffective in preventing urea hydrolysis when fed with high quality diets but may alter the rumen fermentation pattern. Zinc is known to be essential for sexual maturity, testicular functioning and onset of estrus. Cows and heifers fed supplemental zinc had fewer days to first estrus than cows and heifers devoid of supplementation (Campbell *et al.,* 1998). Zinc enhances both cellular and humoral immunity of animals and tends to increase the level of immunoglobulin in colostrum, thereby has direct influence on the immunity of claves (Nayeri *et al.,* 2014). In high yielding animals Zinc supplementation decreases the somatic cell count in milk and increases the level of production. The concentration of zinc in the plasma, liver, pancreas and kidneys increases directly with the dietary level of zinc, hence zinc supplementation increases the functional reserves of zinc in ruminants.

Different levels of supplemental zinc have been provided to animals in different experiments. Zn concentrations of 500mg/kg of diet might cause toxicity in beef cattle, however most livestock species tolerate concentrations well above 1000 mg/kg in the diet. Feeding lactating Holstein cows with diets containing 1000ppm of Zn in the form of zinc sulfate had no adverse effect on milk production, feed intake, body weight, health and reproduction. After feeding 4g and 6g bolus of zinc compound to ruminants, it was reported that animals fed 6g bolus showed symptoms like diarrhea and low feed intake, however, 4g bolus gave satisfactory results without showing any toxic signs (Nemec, 2010). Similarly, increasing the level of zinc from 60 ppm to 300 ppm in diet doesn't incur any ill effects in ruminants. Supplemented yearling cattle with 360 ppm zinc above the basal diet did not produce any significant difference in the serum, liver,

kidney and pancreas zinc concentration. It can be concluded that supplementation of zinc at lower dietary levels will provide better outcome.

Toxicity of zinc is more common in sheep than in cattle. Clinical symptoms include inappetance, loss of condition, diarrhoea with dehydration or subcutaneous oedema, profound weakness, anemia and jaundice (Allen *et al.,* 1984). Organs like liver, kidney and pancreas tend to sequester zinc making it unavailable with the consequence results of significant rise in the concentration of zinc in these organs.

ZINC AS A THERAPEUTIC AGENT

Zinc has been deemed as a therapeutic agent and is routinely used by medical practitioners for the treatment of various diseases. There is hardly any research to assess the therapeutic potential of zinc in animals. However, a number of studies have shown that zinc therapy helps in the prevention of various diseases like New-castle and Marek's disease in poultry on account of increased production of vibriocidal antibodies post vaccination. Zinc is essential for the immune system and its deficiency has dramatic implications on immune functions. Hence, it is not surprising that zinc deficiency increases the risk for several infectious diseases like diarrhea, pneumonia, and influenza. Supplementation of the same tends to reduce the incidence of these diseases. Delayed wound healing and skin lesions are among the symptoms of zinc deficiency, and these conditions tend to reverse with zinc supplementation.

CONCLUSION

Zinc deficiency is one of stumbling blocks in achieving the higher productivity in livestock. The main reason of zinc deficiency in ruminants is the inadequate quantity of zinc in the forages grazed by the animals which is largely due to zinc deficiency in soil. Supplementation of zinc thus becomes inevitable. Moreover, the therapeutic properties of zinc and its relative innocuous nature at higher supplementation make it ideal for ruminants.

REFERENCES

Allen, J.G., Masters, H.G., Peet, R.L., Mullins, K.R., Lewis, R.D., Skirrow, S.Z. and Fry, J. 1984. Zinc toxicity in ruminants. *Journal of Comparative Pathology.* 93: 363-377.

Campbell, M.H and Miller, J.K. 1998. Effect of supplemental dietary vitamin E and zinc on reproductive performance of dairy cows and heifers fed excess iron. *Journal of Dairy Science,* 8:2693-9.

Maan, N.S., Mandal, A.B., Yadav, P.S., Lall, D. and Gupta, P.C. 2003. Mineral Status of Feeds and Fodders in Rohtak District of Haryana. *Animal Nutrition and Feed Technology*, 3:1-7.

Nayeri, A., Upah, N.C., Sucu, E., Sanz-Fernandez, M.V., DeFrain, J.M., Gorden, P.J and Baumgard, L.H. 2014. Effect of the ratio of zinc amino acid complex to zinc sulfate on the performance of Holstein cows. *Journal of Dairy Science*, 97:4392-4404.

Nemec, L. M. 2010. The bioavailability of zinc and copper in holstein steers. Dissertation. University of Delaware.

Shinde, P., Dass, R. S., Garg, A. K., Chaturvedi, V. K. and Kumar, R. 2006. Effect of zinc supplementation from different sources on growth, nutrient digestibility, blood metabolic Profile, and immune response of male guinea pigs. *Biological Trace Element Research.* 112:247-262.

Yadav, S. and Khirwar, S.S. 2000. Soil-plant-animal relationship of zinc in milch buffaloes of Jind district in Haryana, *Indian Journal of Animal Science.* 70:965-967.

Tumours and immune system

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In the process of carcinogenesis, despite the development of a specific immune response, spontaneous removal of the tumour by immune mechanisms rarely occurs. Attempts to apply immunotherapy to strengthen the natural tumour specific immune response also have limited clinical application. This is mainly because cancer cells have a variety of strategies to escape from immune surveillance. Escape mechanisms of tumour cells include avoidance of recognition and modulation of the immune functions of effector cells, usually leading to immunosuppression, which facilitates tumour progression and metastasis.

TUMOUR AND IMMUNE SYSTYEM

The tumor antigens recognized by T cells are tumor-specific antigens and tumor-associated antigens. The tumor-specific antigens are expressed exclusively by tumors and arise from mutations or translocations of normal cellular genes (e.g., β *catenin, cdk4, ras*). The mutations may be involved directly in carcinogenesis. The tumor-associated antigens are not only expressed by tumor cells, but are also expressed by other cells of the body. Overexpressed nonmutated proteins (e.g., p53, Her2/neu) may also serve as tumor antigens for T cells. In addition, tumor-infiltrating lymphocytes have been identified that are reactive against differentiation antigens present on normal melanocytes as well as melanomas (e.g., MART-1/Melan-A, tyrosinase, gp100). Moreover, antigens from tumorigenic viruses are presented on tumor cells. The expression of tumor antigens may be heterogeneous within a tumor, and a single patient can develop immune reactions to multiple antigens.

Two different models for the immune response to tumors have been proposed are the concept of immunosurveillance and the danger model. According to the immunosurveillance hypothesis, tumors expressing antigens are regarded as “nonself” by the immune system. In the presence of danger signals, antigen-presenting cells (APC) such as dendritic cells, activated macrophages, and B cells—stimulate the T cell response. The danger model proposes that cancer cells do not appear dangerous to the immune system, so that the response of T cells to tumors is not initiated.

Natural killer (NK) cells of the innate immune system also play an important role in immune surveillance of tumors. NK cells kill MHC class I-deficient cells—a phenomenon that is part of the "missing self" hypothesis. Two families of inhibitory receptors have been identified in humans: the immunoglobulin-like killer cell inhibitory receptors and the lectin-like CD94-NKG2 receptors. Stimulatory receptors comprise receptors (e.g., CD16, CD94-NKG2C, natural cytotoxicity receptors) that are supposed to bind to constitutively expressed ligands and NKG2d receptors, which bind to molecules that are induced by cellular stress.

Macrophages and neutrophils can also reject tumors by direct killing of the tumor cells, by destruction of tumor vessels and matrix, and by inhibition of angiogenesis. They also display tumor antigens and can stimulate other immune cells such as CTL, NK cells, or APC. In contrast, inflammatory cells may also contribute to tumor progression by production of tumor growth factors and stimulation of angiogenesis. Macrophages and neutrophils are recruited to the tumor site by expression of adhesion molecules on endothelial cells and by chemotactic proteins.

TUMOR IMMUNE ESCAPE MECHANISMS

Equipped with variety of preventive mechanisms, in many cases the immune system does not get activated but "ignores" the tumor. The immune system ignores tumor cells, which fail to migrate to lymph nodes and fail to activate T cells directly. In addition, tumors growing in immune privileged sites such as the brain or the eye are not surveilled by the immune system. The adhesion molecule down-regulations in malignant tissue may inhibit immune infiltration. The tumor stroma has also been shown to serve as a physical barrier between the tumor and immune cells.

The tumors continue to grow despite cancer immunotherapy that generate an anti-tumor immune response, e.g., by vaccination with cancer cells fused with APC or by transfer of anti-tumor T cells. Multiple mechanisms have been identified that tumors use to escape from rejection.

1. Impaired antigen presentation strategy of tumor: Impaired antigen presentation strategy of tumor: to escape from the adaptive immune response and are more pronounced in metastatic lesions than in the primary tumor. Some tumors show down-regulated expression of the tumor antigen, leading to enhanced tumor incidence and metastasis. Mutations of the antigen can result in heterogeneous expression of multiple antigens may hinder the establishment of an efficient specific immune response. In addition, reduced MHC-I expression prevents recognition of tumor cells by the immune system. Tumors frequently have a heterogeneous pattern of MHC-I expression. Total loss of MHC-I mainly caused by mutations of the β2- microglobulin subunit and make the tumor prone for NK cell attack. Therefore to resist NK cell-mediated lysis, tumors express MHC-I surrogates. Down-regulation of the proteasome subunits LMP2 (low molecular mass polypeptide 2) and LMP7 changes the spectrum of peptides presented by MHC molecules. Two proteins involved in loading antigenic peptides onto MHC-I molecules, TAP (transporter associated with antigen processing) and tapasin, are also frequently mutated or down-regulated in tumor cells. Some

tumorigenic viral proteins are not efficiently presented because they interfere with their proteosomal proteolysis.

2. **Expression of immunosuppressive**: This is another strategy that tumors use to evade immune mechanism. These factors may be expressed by the malignant cells themselves or by noncancerous cells present at the tumor site, such as immune, epithelial, or stromal cells. The most prominent of these factors is a cytokine called transforming growth factor β (TGF-β). TGF-β affects proliferation, activation, and differentiation of cells of innate and adaptive immunity and thus inhibits the anti-tumor immune response. Vascular endothelial growth factor (VEGF) is produced by many tumor cells, which has angiogenic properties and inhibits the differentiation of progenitors into dendritic cells. Other immunosuppressive factors expressed by malignant cells are prostaglandins, interleukin (IL)-10, macrophage-colony stimulating factor, and soluble tumor gangliosides.

3. **Induction of tolerance**: T cells show tolerance against tumor-associated antigens that are also expressed by other cells of the body or during development. The induction of tolerance is necessary to prevent autoimmunity. One such mechanism is the induction of anergy. T cell activation requires two signals, binding of a peptide-MHC complex to the TCR and binding of costimulatory molecules (e.g., B7) to their ligands (CD28) on the T cell surface. If a T cell binds via its TCR to a peptide-MHC complex on the target cell without sufficient costimulation. Many tumor cells do not express costimulatory molecules and thus may induce anergy in anti-tumor lymphocytes. Another process of tolerance induction is immune deviation. In this process, the immune response is driven toward a Th2 humoral response away from a Th1 response required for efficient tumor rejection by cytotoxic T cells. A further mechanism to establish tolerance is repetitive stimulation of T cells with the antigen induces apoptosis, a process referred to as activation-induced cell death (AICD).

4. **Resistance of the tumor to the killing mechanisms:** Two further strategies used by tumors to evade rejection by the immune system are related to apoptosis. First, malignant cells have changes in the expression of molecules involved in apoptosis signaling, resulting in resistance of the tumor to the killing mechanisms of the immune system. Second, tumors may adopt a killing mechanism from cytotoxic immune cells to delete the attacking anti-tumor lymphocytes, a concept called “tumor counterattack.”

KILLING MECHANISMS OF THE IMMUNE SYSTEM

T cells and NK cells use two major mechanisms to kill tumor cells:

I. Death receptor pathway
II. Granule exocytosis pathway.

I. **Death receptor pathway**: The lymphocyte displays the death ligand CD95L on the cell surface, triggering apoptosis via the death receptor CD95 on the target cell. Moreover, for immune surveillance of tumors and metastases, NK cells also use the death ligand TRAIL [tumor necrosis factor (TNF)-related apoptosis-inducing ligand], which triggers apoptosis via the death receptors TRAIL-R1 or TRAIL-R2. The so-called decoy receptors are closely related to the death receptors and lack a functional death

domain. Death receptors are activated by their natural ligands, co-evolved as a death ligand family, called the TNF family. When the respective ligand binds to the death receptor, the death domains attract intracellular adaptor proteins, which, in turn, recruit the proform of the "initiator" caspase 8. The resulting protein complex is called death-inducing signaling complex (DISC). At the DISC, procaspase-8 is cleaved autocatalytically and yields the active initiator caspase-8. In some cells, so-called type I cells, the amount of active caspase-8 formed at the DISC is sufficient to initiate apoptosis directly. In type II cells, the amount is too small, and mitochondria are used as "amplifiers" of the apoptotic signal. Activation of mitochondria is mediated by the Bcl-2 homology (BH)3-only Bcl-2 family member Bid, which is cleaved by active caspase-8 and translocates to the mitochondria.

After activation, mitochondria release cytochrome c, apoptosis-inducing factor, and other apoptogenic factors from the intermembrane space to the cytosol. In the cytosol, cytochrome c forms a complex with Apaf-1, adenosine 5′-triphosphate, and procaspase-9. This complex is called apoptosome. Within the apoptosome, the initiator caspase-9 is activated. Activated initiator caspases cleave and activate "executioner" caspases, mainly caspase-3, -6, and -7. The active executioner caspases then cleave each other, and thus start an amplifying proteolytic cascade of caspase activation. The active executioner caspases cleave cellular substrates, the "death substrates," leading to the biochemical and morphological changes characteristic of apoptosis.

II. Granule exocytosis pathway: In the calcium-dependent granule exocytosis pathway, lymphocytes secrete perforin and granzymes from cytotoxic granules toward the target cell. In the presence of calcium, perforin polymerizes and initiates as yet ill-defined changes in the target cell membrane, which allow granzymes to pass into the cell. Granzymes are neutral serine proteases that can activate caspases in the target cell. In addition, granzyme B may directly cleave the Bcl-2 family member Bid, initiating the mitochondrial death pathway. Although it is clear that granzymes are indispensable effector molecules in a granule exocytosis-mediated host defense against viral pathogens, their contribution to tumor rejection remains controversial, as mice deficient for granzymes A and B are capable of rejecting tumors in an efficient way.

Macrophages and neutrophils use totally different killing mechanisms. Mainly, they use four kinds of cytotoxic molecules:

1. **Oxidative burst:** The first effector mechanism is the oxidative burst consisting of the release of reactive oxygen species (superoxide anion, hydrogen peroxide, and derivatives) produced by the phagocytic reduced nicotinamide adenine dinucleotide phosphate oxidase (NADPH).
2. **Production of nitric oxide (NO):** A further cytotoxicity mechanism is the production of nitric oxide (NO) by the inducible NO synthase. The toxicity of NO is enhanced greatly by reacting with superoxide to form peroxynitrite. The molecular targets of reactive oxygen species, NO, and derivatives inside the target cells are not fully defined yet, but may include enzymes essential for cellular survival.

3. **Release antimicrobial peptides:** Release of defensins and cathelicidins, which have affinity for bacterial and eukaryotic membranes and may lyse cells by disrupting the phospholipid bilayer.
4. **Production and release of a variety of proteases:** Elastase, proteinase 3, and metalloproteases. These proteases degrade extracellular matrix components and other proteins.

RESISTANCE TO APOPTOSIS AND IMMUNE ESCAPE

Resistance of tumor cells to the effector mechanisms of the immnue system leads not only to escape of the tumors from immunosurveillance, but may also dramatically influence the efficacy of immunotherapy. Mechanisms of tumor resistance to apoptosis are as following:

I. Overexpression of antiapoptotic molecules
II. Down-regulation or inactivation of proapoptotic molecules
III. Deletions and mutations of the death receptor

I. Overexpression of antiapoptotic molecules

Overexpression of FLIPL: The antiapoptotic proteins FLIPL, interferes with apoptosis induction at the level of death receptors, but do not prevent apoptosis by perforin/granzyme. Tumors with high expression levels of FLIPL were shown to escape from T cell-mediated immunity in vivo despite the presence of the perforin/granzyme pathway. Viral analogs of FLIP, viral FLIPs (v-FLIPs), are encoded by some tumorigenic viruses, such as Kaposi sarcoma-associated herpesvirus (KSHV). KSHV-FLIP promotes tumor establishment and growth in immunocompetent mice by prevention of death receptor-induced apoptosis triggered by T cells. Therefore, v-FLIPs may contribute to immune escape of v-FLIP-encoding viruses.

Enhanced Bcl-2 expression: It is found in follicular B-cell lymphoma (Bcl). In cooperation with the oncogenes c-Myc or promyelocytic leukemia retinoic acid receptor α, Bcl-2 contributes to tumorigenesis. In some studies, high Bcl-2 expression correlates with the grade of malignancy of human tumors. It has been shown that Bcl-2 expression confers resistance to CD95L and other apoptosis stimuli. In some types of tumors, high Bcl-2 expression appears to be predictive of a poor disease-free survival. The tumor-associated viruses Epstein-Barr virus and human KSHV encode proteins that are homologs of Bcl-2. Both proteins, BHRF1 or KSbcl-2 (vBcl-2), respectively, have an antiapoptotic function and enhance survival of the infected cells. Thus, they may contribute to apoptosis resistance of virus-induced tumors. In addition, the antiapoptotic Bcl-2 family members Bcl-xL and Mcl-1 are up-regulated in tumors and can confer resistance to multiple apoptosis-inducing pathways.

Enhanced expression IAP family: Survivin, IAP family member is expressed in a highly tumor-specific manner. It is found in the vast majority of human tumors, but not in normal adult tissues. In neuroblastomas, expression correlates with a more aggressive and unfavorable disease. Another IAP family member, cIAP2, is affected by the translocation t(11;18)(q21;q21) that is found in about 50% of marginal cell lymphomas

of the mucosa-associated lymphoid tissue (MALT). This suggests a role of cIAP2 in the oncogenesis of MALT lymphoma.

II. **Down-regulation or inactivation of proapoptotic molecules: Tumors can also** acquire apoptosis resistance by down-regulation or inactivation of proapoptotic molecules. In comparison to their normal counterparts, some tumor cells show a decreased expression of the death receptor CD95. This has been demonstrated for hepatocellular carcinomas, neoplastic colon epithelium, melanomas, and other tumors. Loss of CD95 may contribute to chemoresistance and immune evasion by transcriptional mechanisms. Oncogenic Ras seems to down-regulate CD95, and in hepatocellular carcinomas, loss of CD95 expression was accompanied by p53 aberrations. The mutations include point mutations in the cytoplasmic death domain of CD95 and a deletion leading to a truncated form of the death receptor. These mutated forms of CD95 may interfere in a dominant-negative way with apoptosis induction via CD95.

III. **Deletions and mutations of the death receptors:** TRAIL-R1 and TRAIL-R2 have also been observed in tumors. The frequent deletion of the chromosomal region 8p21-22 in head and neck cancer and non-small cell lung cancers affects the TRAIL-R2 gene. Further mutations result in a truncated form or other antiapoptotic forms. Down-regulation or mutation of death receptors may hinder with NK and T cells tumor immunosurveillance.

CONCLUSION

It is an especially vital issue because neoplasms are currently one of the most frequent diseases of affluence and they constitute a serious problem both in human and veterinary medicine. Rapidly growing number of animals with oncological problems, observed particularly in the area of urban agglomerations, constitutes significant evidence that there is an urgent need for fundamental understanding of complicated interactions between a neoplasm and the immune system.

REFERENCES

U. Lisiecka and K. Kostro. 2016. Mechanisms of tumour escape from immune surveillance. J Vet Res 60, 453-460.

Azuma M. 2010. Role of the glucocorticoid-induced TNFR-related protein (GITR)-GITR ligand pathway in innate and adaptive immunity. Crit Rev Immunol, 30, 547–557.

Huye L.E., Dotti G. 2010. Designing T cells for cancer immunotherapy. Discov Med, 47, 297–303.

Silicon Nutrition for Improved Crop Production

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Abstract

Although Silicon (Si) is one of the most abundant elements found in most soils in substantial quantities, sandy soils greatly exhibits the deficiency of Silica in upper horizons. In these soils, plants such as sugarcane and rice, which have ability to accumulate Si in their tissues, can respond favorably to silicon fertilization. Silicon has a key role in plant-environment relationships as it improves ability of plants to withstand edaphoclimatic and/or biological adversities by acting as a "natural anti-stress" mechanism that enables higher yields and quality product. Silicon plays a large number of diverse roles in plants, and does so primarily when the plants are under stressful conditions. A practical approach for enhanced Si nutrition of crops is to use $CaSiO_3$ products as a liming material. High-value horticultural crops may benefit for soluble Si fertilizers, applied through drip irrigation systems. Hence, future research should emphasize upon adoption of proper silicon fertilization strategies, selection of soluble sources of Si fertilizers, rate of application for improved crop production.

INTRODUCTION

Plant growth is a function of different environmental factors such as light, temperature, water, humidity and nutrition. In addition, it is greatly influenced by different pathogens and insects/pests resulting in low yield. Better understanding of these factors and their role is pre-requisite to gain maximum benefits in terms of growth and yield. Nutrition is the most important among all and plays a crucial role in maintaining plant growth and tolerance to different biotic and abiotic stresses. Sixteen mineral elements have so far been identified essential for growth. Although, essentiality of element like Silicon in crops has not been recognized but it is considered as beneficial element due to its immense role in alleviating stress. In this scenario, inclusion of Si in nutrient management seems promising for enhancing crop productivity.

SILICON AND ITS OCCURRENCE IN NATURE

Silicon (Si) is the second most abundant element on earth, which is composed of 27.7% Si, next to oxygen. In nature, Si only occurs in combination with other elements. The element occurs in two forms: silica or the oxides of silicon, which exist in crystalline or amorphous forms. Silicate refers to Si-containing crystalline or amorphous compounds such as calcium silicate ($CaSiO_3$), magnesium silicate ($MgSiO_3$), sodium silicate (Na_2SiO_3), or potassium silicate (K_2SiO_3). It mainly occurs as an inert mineral of sands, quartz (SiO_2), kaolinite, mica, feldspar and other clay minerals. Because of its abundance, it is typically not considered as a limiting factor in soil fertility. However it imparts tolerance to crops against various stresses and improves quality. Hence it is considered as a beneficial element with regard to crop nutrition.

REACTIONS OF SILICON IN SOIL

In soil solution, available form of Si is found in form of silicic or monosilicic acid (H_4SiO_4). The main sources of Si in soil solutions are decomposition of plant residues, weathering of primary minerals, secondary clay silicates and Si fertilizers and irrigation water. Si fertilizers are mostly neutral or slightly alkaline in reaction. The neutralizing effect promoted by silicates on soil acidity occurs through following reactions:

$$CaSiO_3 + H_2O \leftrightarrow Ca^{2+} + SiO_3^{-2} + H_2O$$
$$SiO_3^{-2} + 2H^- \leftrightarrow H_2SiO_3$$
$$H_2SiO_3 + H_2O \leftrightarrow H_4SiO_4$$

SILICON UPTAKE AND TRANSPORT IN PLANT

Silicic acid or mono silicic acid ($Si(OH)_4$ or H_4SiO_4) is the soluble and plant-available forms of Si. It is absorbed by plant roots in its neutral form (H_4SiO_4) via xylem through passive process regulated by transpiration stream or by active process, through Si transporters located in plasma membrane of root cells. The absorbed Si accumulates in oldest tissues, mainly in walls of epidermal cells, cuticles and intercellular space as polymerized monosilicic acid or amorphous silica ($SiO_2 \cdot nH_2O$), which strengthens cell walls and increases the structural rigidity of tissues (Fig 1a, b). In general, plants have Si concentration ranging from 0.1 to 10% of their total dry matter.

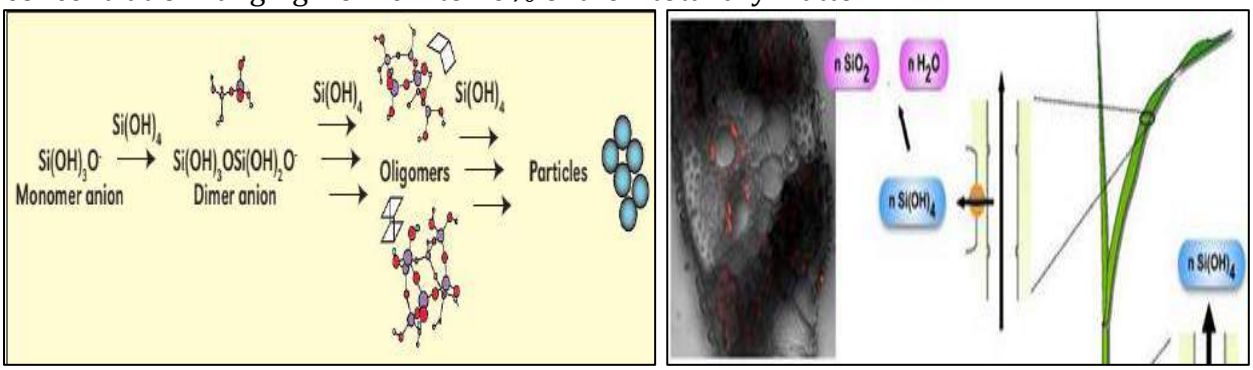

Fig 1: a) Polymerization of monomeric silicic acid to larger silica particles through condensation reactions involving dimers, oligomers and aggregates as intermediates; b) Cross section of plant epidermis showing silica deposition (Currie and Perry, 2007).

POTENTIAL BENEFITS OF SILICON NUTRITION

Silicon is classified a "beneficial nutrient" in plant biology. The manifold role of Si in crops in generation of defense mechanism can be used to term it as 'quasi-essential' element besides improving crop yield. One major contribution of Si is reinforcement of cell walls by deposition of solid silica. A second mechanism includes its role in triggering a range of natural defenses through the activity of secondary metabolites.

However, regardless of the mechanism, potential benefits due to Si nutrition (Fig 2) include:

- Direct stimulation of plant growth and yield through upright growth and plant rigidity
- Improved nutrient availability
- Resistance against pest and diseases
- Improved resilience to Environmental Stress (lodging, drought, temperature, chemical stresses)

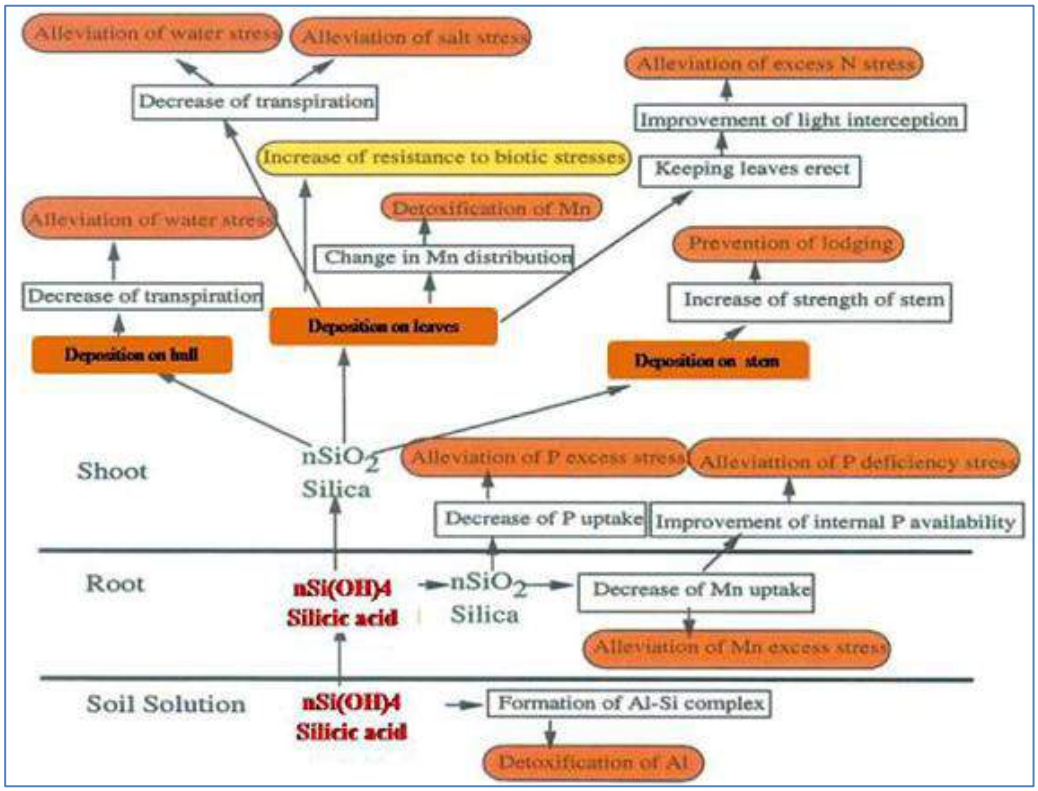

Fig 2. Beneficial effects of Si under various stresses (Ma, 2004)

SOURCES OF SILICON

Crop residues (wheat straw and small grain crops), animal manures, and composts are all potential sources of Si. Wheat straw supplies around 0.15-1.2% Si. Silicon in crop residues may take many years to dissolve and become available for plant uptake. To be beneficial for plants, Si amendments should provide a high percentage of Si in a soluble form. Calcium silicate produced as by-product from steel mill slag is the most commonly

used Si amendment for field application that also neutralizes soil acidity and supplies Ca.

Other sources of Si includes

- Magnesium silicate
- Potassium silicate
- Sodium silicate
- Diatomaceous earth (80 to 90 % SiO_2)

Crops likely to benefit from silicon

Plants species varies with regard to the magnitude of silica uptake. In rice, oat, rye and wheat, seed coat accumulates most of the silica. It is observed that leaves and stems of maize, sorghum, sugarcane and bamboo have highest silica than other plant parts. Plants of family Poaceae, Equisetaceae and Cyperaceae exhibit high silicon accumulation (4 % Si), Cucurbitales, Uritcales and Commellinaceae show intermediate levels (2-4 % Si) while most other species contain less silicon (2 % Si) in their tissues.

SILICON FERTILIZATION AND RATE OF APPLICATION

Common sources of silicon for horticultural applications include potassium silicate, calcium silicate and sodium silicate. Application to the soil is recommended over foliar sprays if uptake is to be optimized. High value crops may benefit from drip applications of soluble silicon such as sodium silicate and potassium silicate, or calcium silicate in soil-less mixtures. Application rates of Si can be determined by soil pH or lime requirement of the soil. Hence, there is an array of silicon sources available but it is important to consider soil type, crop, application method and other potential benefits (soil amelioration through liming).

NOVEL SILICON FERTILIZATION STRATEGIES

In general, silicon fertilization has been proved to be beneficial when silica concentration falls below 1 % in plant tissues. Unlike conventional fertilizers, Si fertilizers are available only in limited quantities and also expensive. Some silicon fertilization strategies are as follows:

- ❖ Recycling of organic siliceous materials (straw, husk)
- ❖ Addition of silicate amendments
- ❖ Use of liquid silicon fertilizers for foliar spray
- ❖ Application of nano-silica with high bio-availability
- ❖ Inoculation of organic siliceous materials with silicate solubilizing bacteria (SSB) *viz., Bacillus caldolytyicus, Bacillus mucilaginosus* var *siliceous, Proteus mirabilis, Pseudomonas* and *Penicillium.*

CONCLUSION

The depletion of available Si in soil is an important soil related factor that may be closely associated with progressive yield declines experienced in various crops, especially in the tropics. To date the issue of Si nutrition in crop production remains largely unexplored. Identifying and implementing Si nutrition management strategies

may play critical role in improving crop production. There is a need for applied research to quantifying monosilicic and polysilicic acid contents to elaborate optimum Si rate and best time and methods of its application. Hence, it is imperative that the silicon nutrition is a novel nutrient management strategy to improve crop growth and production.

REFERENCES

Ma, J.F. 2004. Role of silicon in enhancing resistance of plants to biotic and abiotic stresses. *Soil Sci Plant Nut.,* 50(1): 11-18.

Currie, H.A. and C.C. Perry. 2007. Silica in Plants: Biological, Biochemical and Chemical Studies. *Annals of Botany.,* 100: 1383-1389.

Sorghum cultivation in rice - fallow conditions of North coastal Andhra Pradesh

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Abstract
In climate changing situation, sorghum is emerging as a potential alternative feed, fodder and bio-energy besides, food crop. However, the area under kharif sorghum cultivation is decreasing rapidly due to various reasons. The situation demands a search for potential niches for its cultivation in non-traditional areas. Sorghum cultivation in rice-fallows with an average productivity of 6.5 t /ha, which is the highest in the country, is a valuable opportunity.

Key words: Sorghum, Fodder, Cultivation, rice fallow and average productivity.

INTRODUCTION

Sorghum (*Sorghum bicolar* L. Moench) is an important staple food for millions of people in the semi arid tropics. It is also emerging as a potential alternative feed, fodder and bio- energy crop. Moreover, its resilience to high temperature and drought makes its a climate ready crop. Infact, the area under sorghum cultivation is decreasing rapidly changing food habits and socio economic status of people, competition for commercial crops like Sugarcane, cotton, soyabean etc. Marketing facilities, government policies etc. Under this situation new niches of sorghum cultivation, the search for new niches of sorghum cultivation in rice fallows under zero- tillage condition is new area of interest. It is now grown in more than 6500 ha area in rice fallows with an average productivity of 6.5 t/ha, which is the highest in the country. Sorghum after rice gave the highest output energy of 59.1 $x10^3$ MJ/ha as compared to rice-pigeonpea and rice-safflower (Mahendra Kumar, 1997). Improved production practices for zero-till sorghum cultivation in rice fallows are lacking. The farmers are using fertilizers and pesticides indiscriminately due to lack of standardized technologies. Although they are getting higher yields but the profit margin could be increased by developing and demonstrating cost-effective technologies.

In recent years, sorghum cultivation in rice-fallows during late-*rabi* is gaining popularity in coastal Andhra Pradesh, especially in Guntur and adjoining Krishna and Prakasham districts due to insufficient water for second crop of rice. The farmers are planting sorghum after harvest of rice in mid-December under zero-tillage to utilize the

residual soil moisture. The crop is harvest during first week of April. Usually, farmers grow pulses (greengram and blackgram) in rice-fallows of the Krishna-Godavari zone of Andhra Pradesh as *utera* cropping (broadcasting of seeds in standing crop of rice). This practice helps the farmers to harness the residual moisture, and at the same time increasing nitrogen content in soil by biological nitrogen fixation. However, in the recent times, the area under pulses has declined due to late planting of rice and severe attack of viral diseases and parasitic weed *Cuscuta* (Mishra *et al.* 2009). The farmers of the coastal area having assured irrigation facilities have now shifted to maize and those with limited irrigation to sorghum (Chapke *et al*.2011). The area under sorghum in rice-fallows has increased from 2000 ha in 2005-06 to more than 24000 ha during 2014-15, with an average productivity of 6.5 t/ha, which is the highest in the country. Sorghum also requires fewer inputs such as nutrients and plant protection measures as compared to maize. Farmers of the area are harvesting up to 6-7 t/ha sorghum grains depending up on management practices. Keeping in view the scarcity of irrigation water in future, the area under sorghum is expected to increase.

PACKAGES AND PRACTICES OF RICE FALLOW SORGHUM

Seed treatment

Before sowing, treat sorghum seed with 14 ml Imidacloprid (*Goucho*) + 2 g Carbendazim (*Bavistin*) for one kg of the seed, or iomethaxam (*Cruser*) 3 g/kg of seed.

Time of sowing

The time of sowing of sorghum in rice-fallows depends solely on the time of *kharif* paddy harvesting as the crop is sown on the residual soil moisture. In general, 2nd to 3rd week of December is an ideal time. Delayed sowing in January affects the seed setting and grain filling due to high temperature in March and April. Sometimes unusual rains in coastal areas during April causes heavy damage in sorghum.

Method of sowing and seed rate

The crop is sown in zero tillage after harvesting of paddy. The sowing is done manually in rows (40x15cm apart) at 4-6 cm depth by making a hole with wooden stick and putting 2-3 seeds in each hole. Making holes manually for sowing is however, time consuming back breaking and costly. Therefore manually operated small implement (Fig. 13.2) and tractor operated hole maker have been developed for easy and timely sowing. Around 8-10 kg seed/ha is required for optimum plant population. Maintain plant population as 1,80,000 plants per ha (72,000 plants per acre)

Figure 1: Line sowing in rice fallow sorghum

NUTRIENT MANAGEMENT

In rice-fallows, the farmers were applying higher dose of fertilizers in the range of 120 kg N, 80 kg P_2O_5 and 80 kg K_2O per ha. Typically, no basal fertilizer was applied at the time of sowing but around 30 days after sowing (just before Ist irrigation), a mixture of 60- kg /ha N and 75-80 kg/ha $P2O_5$ was side dressed to individual plant in rows manually. At 60 days after sowing (just before 2nd irrigation) 60 kg N and 75 kg K_2O /ha were applied.

Figure 2: Fertilizer application in rice fallow sorghum

WEED MANAGEMENT

Weeds including grassy and broadleaf were a major problem in rice-fallows under zero tillage.They emerged even before sorghum sowing and had an advantage over the main crop for available resources. Grassy weeds especially *Echinochloa* spp. were the major weeds infesting the crop. Therefore, both; pre-emergence and post-emergence weedicides were useful under this zero tilled condition. The farmers wisely sprayed both, paraquat (post emergence) + atrazine (1.0+0.5 kg/ha) (pre-emergence) one day after sowing for effective weed control. Paraquat controls already existed (emerged weeds) and atrazine acts as pre-emergence i. e. to control emerging weeds along with sorghum .

INSECT-PESTS MANAGEMENT

Due to high humidity in coastal regions, heavy infestation of insect-pests and diseases was observed. Among major pests, shootfly, aphids and stem borer were dominant. For effective control of shootfly, the farmers were spraying cypermethrin @ 2 ml/l of water at 1 week after germination and again giving need-based spray at two weeks interval. On the basis of improved practices of other crops, they were applying furadon 3G granules (@10-12 kg per ha) in leaf whorls of individual plant manually after 30-35 days of sowing.

Figure 3: Blackgram infested with yellow vein mosaic disease and weeds in rice-fallows

Spraying of insecticides **Application of 3G Furadon granules(Whorls)**

IRRIGATION MANAGEMENT

Two irrigations are sufficient to harvest good sorghum yield whereas, maize required four irrigations and hence, its preference were number of irrigations were limited. The farmers were judiciously using available water by giving first irrigation at 30 days after sowing (DAS) and second at 60 DAS.

HARVESTING AND THRESHING

In the coastal areas, strong winds in March and April due to low pressure was resulting in severe damage of crop. Therefore, the farmers harvested the crop at early maturity stage (105-110 days) to avoid losses from cyclonic rains. After harvest, the panicles were sundried for a week and later processed. On an average, sorghum grain yield ranged from 6.5 t/ha, 7.5 t/ha in these rice fallows. The sorghum productivity potential of improved cultivars was attained due to intensive crop management by the farmers.The farmers were able to earn gross returns of Rs. 92,400/- per ha (with an average market price @Rs.1200/- per quintal) excluding fodder price. All the farmers

sold the produced grains in the local markets after harvest. The highest fodder yield was also recorded (10-12 t/ha).

Figure 4: Harvesting of sorghum crop

Drying / Bagging

After threshing the grains are sundried for 1-2 days to reduce the moisture content up to 10%. Bagging of the grains is done in plastic or gunny bags for immediate marketing.

Economics

On an average, farmers' expenditure incurred on sorghum cultivation was Rs. 29000–30000 per ha which could produce an average 7.70 tonne per ha grain with CSH 16,was resulted into net profit of around Rs.63000 /ha. Component-wise cost and benefits are highlighted in Table 4. However, the cost of stover was not included in the net benefit as it is either burnt or incorporated in the soil.

Suitable sorghum hybrids under rice fallow conditions of coastal A.P.

1.CSH 25

It is a hybrid developed by AICRP on Sorghum, Parbhani during 2007. It is a cross between PMS 28A x C 43. It matures in 110-115 days. The hybrid is characterised by its medium tall , semi compact panicle, medium almond seeds. The hybrid is resistant to grain mould and aphid. It has the potential to yield 40-45 q ha^{-1} of grain and 120 q ha^{-1} of stover.

CSH 25

2. CSH 16

It is a hybrid developed by IIMR, Hyderabad during 1997. It is a cross between 27A x 43. It matures in 110 days. The hybrid is characterised by its medium nature, long cylindrical panicle, medium bold seeds. The hybrid is tolerant to grain mould and

resistant to leaf spot disease. It has the potential to yield 60-65 q ha^{-1} of grain and 95 q ha^{-1} of stover.

CSH 16

3.CSH 15 R

It is a hybrid developed by Centre of Sorghum Research, Solapur during 1995. It is a cross between 1404A x RS585. It matures in 110 days. The hybrid is characterised by its tall nature (upto 250cm), having large semi compact panicle, pearly white, round and bold seeds. The hybrid is tolerant to shootfly and charcoal rot. It has the potential to yield 32 q ha^{-1} of grain and 56 q ha^{-1} of stover.

CSH 15R

4. MLSH-296 (Private hybrid)

It is a private hybrid released during 1997. It matures in 110-115 days. The hybrid is characterised by its short stature (130 cm), having compact panicle, round seeds. The hybrid is resistant to grain mould and shootfly. It has the potential to yield 70-85 q ha^{-1} of grain and 90 q ha^{-1} of stover.

MLSH -296 (Private hybrid)

Table 1. Economics of sorghum cultivation in rice-fallows

Sr. No.	Particular	Cost (Rs. ha^{-1})
1	Seed	1125
2	Fertilizers	6926
3	Herbicides	1250
4	Pesticides	3750
5	Irrigation	5000
6	Labour	11250
7	Total cost of production	29301
8	Gross returns	92400
9	Net returns	63099
10	B:C Ratio	3.15:1

**Excluding fodder's price, selling price of sorghum grain @Rs. 12000/- per tonne.*

Figure 5: Rice fallow sorghum under zero tillage condition

REFERENCES

Mishra J S, Rayudu, B S and Chapke R R. 2009. Sorghum-a potential high yielder in rice-fallows of Andhra Pradesh. ICAR News, 15 (4): 8.

Chapke RR, Mishra JS, Subbarayudu B and Hariprasanna K. 2011. Evaluation of sorghum production technologies in rice-fallows *Poster*, *National Seminar on Millets* at Hyderabad, November 12-13, 2011.

Mahendra Kumar R, Murthy G R K and Subbaiah S V. 1997. Energy dynamics of ricebased

cropping systems under different methods of rice cultivation. *Journal of Agricultural Engineering* 34 (2): 17-25.

Organic Cultivation of Potato

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Organic potato production generally fits into a planned rotation on an organic farm. It is possible for a specialist potato farmer to grow organic potatoes on an organic farm. All other organic standards will still need to be implemented and the farmer will have to register with a certification body. It may also be possible to have a single field in organic crop production, providing it operates a suitable planned rotation, and organic potatoes can be adequately isolated from any other potatoes grown on the farm. Organic potato production is of interest to many farmers as the crop:

- Is in demand from consumers
- Can be profitable
- Can be a starting point for a break crop from grass in the rotation
- Requires cultivation which help control weeds

CHALLENGES OF ORGANIC POTATOES :

Organic potato production has a number of challenges that must be tackled:

- Providing adequate materials
- Preventing potato blight
- Weed control

Organic producers have to rely on alternative approaches rather than artificial fertilizers and synthetic chemical herbicides and fungicides.

Cultural Practices :

Soil :

The soil should be friable, porous and well drained. The optimum pH range is 4.8 to 5.4. It is a cool weather crop. Potato is mostly grown as a rainfed crop. It is cultivated in regions receiving a rainfall of 1200-2000 mm per annum.

Season and planting :

Hills :

Summer	:	March-April
Autumn	:	August-September
Irrigated	:	January-February

Plains :

October – November

Propagation :

Use disease free, well sprouted seeds weighing 40-50 grams. Plant the tubers at 20 cm apart. Seed rate is 3000-3500 ka/ha.

Selecting potato varieties :

In selecting varieties for organic production there are two simple rules :

- Grow varieties suited to organic production
- Grow varieties which best suit the intended market as with all organic produce, grow what will sell, not what you want to sell.

Kufri Swarna, Kufri Giriraj and Kufri Chipsone-II are suited for organic farming since they are resistant to blight and nematode.

Preparation of field :

Prepare the land to find tilth. In hills provide an inwrd slope of 1.40 in the terraces. Provide drainage channel along the inner edge of the terrace. From ridges and furrows with a spacing of 45 cm between the ridges either by hand hoe or ridger.

Irrigation :

Irrigate the crop 10 days after planting. Subsequently irrigation should be given once in a week.

Manuring :

- Green manuring with lupin 60 days before planting
- Sprinkling horn manure to the soil @75 g/ha by dissolving it in 40 litres of water at the time of land preparation
- Application of well decomposed farm yard manure @ 5t/ha at the time of land preparation
- Application of biodynamic compost @ 5 t/ha at the time lf land preparation
- Application of neem cake @ 1250 kg/ha at the time of land preparation
- Application of biofertilizers like Azospirillum and Phosphobacteria @ 25 kg each/ha at the time of land preparation
- Spraying cow pat pit @ 5 kg/ha in 100 litres of water on 45th, 60th and 75th day after planting
- To increase the pH of the soil, application of dolomite @ 10 tonnes/ha should be done

After cultivation :

Two critical period of weed competition is up to 60 days and it is essential to keep the field weed free during that period. Take up the first hoeing on 45^{th} day without disturbing stolons. Second hoeing and earthing up should be done at 60^{th} day. As no herbicides are permitted, weed control is carried out by :

- Choosing fields with no major weed problems
- Flame weeding of weed seedlings before the potato tops emerge-this can be expensive
- Mechanical weed control just before tops meet between rows

- Limited hand weeding of any large invasive weeds

Growth regulators :

- Foliar spraying of panchagavya @ 3 per cent at 10 days interval from 1st month after sowing
- Spraying 10% vermiwash 5 times at 15 days interval from one month after sowing
- Foliar spray of horn silica @ 2.5 g/ha in 50 litres of water on 65th day after sowing

Plant Protection :

Pests :

Aphids :

- Foliar spry of 10% nettle leaf extract on 45th, 60th and 75th day after sowing
- Foliar spray of 10% garlic-chilli extract on 45th, 60th and 75th day after sowing
- Foliar spray of 3% need oil

Cutworms :

- Install light trap during summer to attract adult moths
- Install sprinkler irrigation system and irrigate the field in day time to expose the larvae for predation by birds
- Application of pyrethrum bait in soil

White grabs :

- Summer ploughing to expose the pupae and adults
- Install light traps between 7 pm and 9 pm in April-May moths
- Hand pick the adults beetles in the morning
- Hand pick in 3rd instar grub during July-August
- Application of Metarrhizium anisopliac @ 20 kg/ha at the time of land preparation

Potato tuber moth :

- Avoid shallow planting of tubers. Plant the tubers at 10-15 cm depth
- Install pheromone traps @ 20 numbers per hectare
- Earth up at 60 days after planting to avoid potato tuber moth egg laying in the exposed tubers
- To control foliar damage, spray 5% neem seed kernel extract
- Keep pheromone traps in godowns
- In godowns cover the upper surface of potato with Lantana or Eupotorium branches to repel ovipositing moths

Diseases :

Potota blight :

Potato blight cannot be cured and particularly in an organic situation, avoidance is definitely the best policy.

- Blight is not generally a problem with early harvested, early varieties
- Plant early varieties if suitable possible
- Plant healthy, blight free seed
- Select varieties with blight resistance

- Listen for and pay attention to blight warnings
- If the blight pressure is high apply a permitted fungicide
- Remove ground creepers which serve as a source of infection
- Spraying Agni Hotra ash (200 g Agni Hotra ash soaked in 1 litre cow urine for 15 days and diluted in 10 litres of water before spraying) 3 times at one month interval from one month after planting

Brown rot :

- Select disease free seeds
- Give proper drainage facilities
- Remove and destroy the affected plants

Virus diseases :

- Use virus free potato tubers
- Rogue the virus affected plants regularly
- Control the aphid vectors by spraying 10% nettle leaf extract on 45th, 60th and 75th day after planting

Nematodes :

- Avoid growing potato year after year in the same field
- Follow rotation of crop with vegetables and green manure
- For cyst nematode, a resistant variety called Kufri Swarna can be grown
- Application of Pseudomonas fluorescens @ 10 kg/ha can be done
- Sow mustard as intercop at the time of potato planting and harvest the mustard greens on 45th day for the control of potato cyst nematode

Haulm removal :

Only physical means of haulm removal are permitted. These include :

(a) Flailing (haulm chopping)
(b) Haulum pulling
(c) Flaming

Chemical methods of desiccation or application of sulphuric acid are not permitted.

Storage :

Normal methods of storage apply to organic potatoes however,

- Adequate isolation from non organic potatoes will be required to avoid substitution or contamination. This may require visibly identifiable varieties only.
- Sprout suppressants and fungicides are not permitted in store.

Yield :

15-20 t/ha duration of 120 days

Testing of soil and water

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(I) WHY TO TEST SOIL AND WATER?

1. To check soil health
2. To find out deficiency, sufficient or toxicity of plant nutrients
3. To investigate physical, chemical and biological properties
4. To prescribe fertilizer nutrients
5. To study quality of water for purpose of irrigation and drinking

(II) HOW TO SAMPLE SOIL AND WATER?

(A) Soil :

1. Make sampling at ploughable condition.
2. Divide the area into sampling unit, one unit represents 2Ha.
3. Locate 20 spots by drawing 'Z' shaped imaginary lines. Leave unusual spots.
4. Scrape weeds from selected spots.
5. Dig 'V' shaped pits by powraha upto 15 cm depth.
6. Atake thin slices from exposed faces.
7. Alternatively use soil augur for sampling.
8. Collect samples in a bucket or tray.
9. Mix the samples thoroughly.
10. Divide into quarters. Take two opposite rides and reject the rest.
11. Take 500g samples by rejecting other two portions.
12. Dry sample under shade. Pack in polythene bags. Level with detailed address and send to lab for analysis.

(B) Water :

1. Discard 1st 8-10 buckets of water from wells of open deaf or dug and then collect.
2. Use 900-1000ml plastic bottles for sampling.
3. 2-10 bottles at 15-25cm depth and fill with water.
4. Running water from canals is collected against the flow.
5. Level with proper information regarding soil and crop to be irrigated.

PROPERTIES TO BE TESTED :

(A) Soil :

(i) Physical
(ii) Texture
(iii) Bulk density
(iv) Particle density
(v) Porosity
(vi) colour

(B) Chemical :

(i) pH
(ii) EC
(iii) Organic carbon
(iv) Nitrogen
(v) Phosphorus
(vi) Potash
(vii) Lime requirement

(C) Water :

(i) pH
(ii) EC
(iii) Hardness
(iv) Chloride
(v) SAR
(vi) Boron
(vii) sulphur

(III) RAPID METHODS OF ANALYSIS :

1. TEXTURE : BY FEEL

Sl. No.	Textural Class	By Finger	Bail Formation	Ribbon Formation
1.	Lcamysand	V.Grity	Breken Ball Dost not stick to finger	No
2.	Sandylsane	M. Grity	Forms ball but 13 breads little strain to finger	No
3.	Loam	Little Smooth	Strong Ball sticks to finger	No
4.	Clay Lcam	Smooth	Strong Ball sticks to finger	Tends to form Ribon
5.	Clay	V. Smooth	Hard Ball	Long Ribon

2. B.D., P.D. and Pore Space :

(i) Take a 100 ml measuring cylinder.
(ii) Put 50g air dry soil = W
(iii) Measure Volume of Soil = V^1 bag 40g

B.D. = $\frac{W}{V_1} = \frac{50}{40} = 1{,}25\ g/cc$

(iv) Transfer the soil, add some water bag 25ml = V_2

(v) Add the soil and make a paste.

(vi) Measure the volume of soil paste = V_3 bag 45 g/cc

P.D. = $\frac{W}{V_3 - V_2} = \frac{50}{40-25} = \frac{50}{70} = 1{,}25\ g/cc$

……= $2.5 - 1.25 \times 100 = 50\%$

(IV) CHEMICAL TEST :

(A) pH : Colouremetrc Method :

Texture	In a Test-tube Soil : Basou	Take
Coarse	3 :1	
Medium	1 : 1	
Fine	3 : 1	

Add 10cc distilled water

10 drops of universal indicator mix for 2 l

Observe the colour

Match the colour with a chart, observe pH

(B) E.C. :

10g soil + 20 ml distill water

Stir with glass rod

Keep for 30 l

Measure E.C. by conductivity meter

(C) Organic Carbon :

1g soil + 1N$K_2Cr_2O_7$ + conc H_2SO_4

Observe intensity of green colour. Mention low, medium or high

(D) Available P_2O_5 :

15g soil + 10 ml Am.C sol. Stake 5 ml Am. Molybdate solution. Add 1 ml stannous chloride. Measure intensity of blue colour.

(E) Available K_2C :

1g soil + 5ml Amm. acetage. 5' shake and filter. 7ml filterate + 0.5 ml cobalt nitrate in 2ml alcohol mixture. Red intensity of orange colour for av.K.

(F) Interpretation :

(1) pH :

Strongly Acidic : <5 C

Moderately Acidic : 5.1-6.0

Mild Acidic : 6.1-6.5

Neutral : 6.6 -7.5

Mildly alkaline : 7.6-8.0

Moderately alkaline : 8.1-9.0

Strongly alkaline : < 9.0

(2) Conductivity : d5/M :

Normal : < 1.0

Critical Germination : 1.1-2.0

Critical for Growth : 2,1-3.0
Harmful : > 3.0

(3) Organic Carbon :

Low	Medium	High
< 0.5%	0.51-0.75%	> 0.75

(4) Available P_2O_5 (kg/ha) :

Low	Medium	High
< 14.0	14.1-40.0	> 40.1

(5) Available K_2O (kg/ha) :

Low	Medium	High
< 125	125.1-280.0	> 280.1

(G) Lime Requirement for Acid Soil :

Textural Class	:	L.R. $CaCO_3$ (ka/ha)
Sandy	:	1000 (1T)
Sandy loam	:	1750 (1.75T)
Loam	:	2500 (2.5T)
Silt loam	:	3500 (3.5T)
Clay loam and clay	:	5000 (5T)

WATER ANALYSIS :

1. pH : Suitable : t.5-8.C

2. EC : ds/m (salanity hazard)

Excellent : < 0.25
Good : 0.25-0.75
Doubtful : 0.75-2.25
Unsuitable : > 2.25

3. Residual Sodium Carbonate (Hardness)

$(CO_3 + HCO_3^-) - (Ca+Mg)$ Meg/L

Safe : <1.25
Marginal : 1.25-2.5
Unsuitable : >2.5

4. Sodium Adsorption Ratio (Sodium Hazard)

SAR : $\frac{Na^+}{\sqrt{\frac{Ca^{2+}Mg^{2+}}{2}}}$

S_1 Excellent : < 10
S_2 Good : 10-18
S_3 Doubtful : 18-26
S_3 Unsuitable : > 26

Various application methods of fertilizers and their role in increasing Nutrients Use Efficiency

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Fertilizer use in India started in 1906. Fertilizer consumption and food grain production increased rapidly after mid 60s that period was called green revolution. During this period new chemical fertilizers made it possible to supply crops with extra nutrients and therefore, increase yield. Evolution of fertilizer responsive HYVs of rice and wheat – a turning point. Low Recovery of N in annual crop is associated with its loss by volatilization, leaching, surface runoff, denitrification and plant canopy. Low canopy of N is not only responsible for higher cost of crop production but also for environmental pollution. Hence, improving NUE is desirable to improve crop yields, reducing cost of production and maintaining environmental quality.

NUTRIENT USE EFFICIENCY

Nutrient use efficiency is defined as the extent to which the nutrients and management practices interact to give a specified yield level.

$$NUE(\%) = \frac{\text{yield with applied Nutrents (Kg/ha)} - \text{yield without applied nutrients (Kg/ha)}}{Amountofappliednutrient(kg/ha)} X100$$

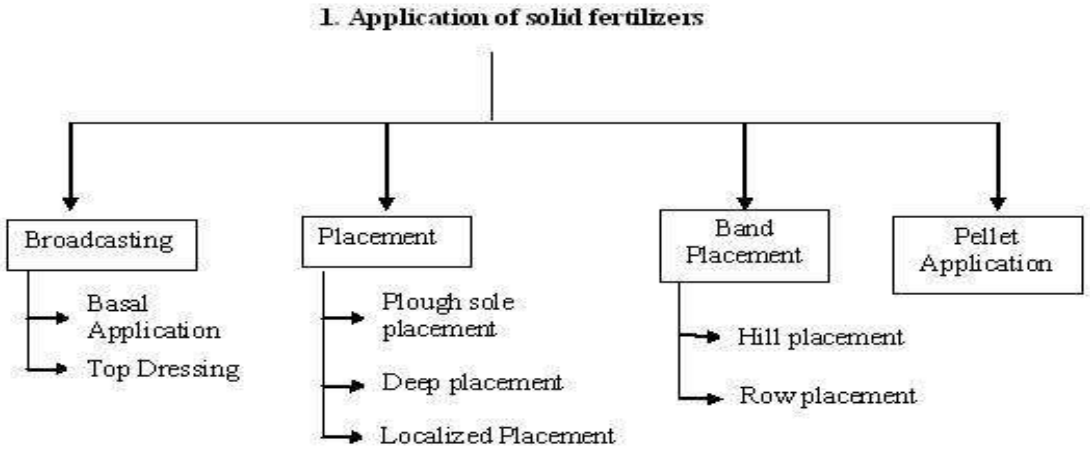
Low Nutrient Use Efficiency

Nutrient	Efficiency	Cause of low efficiency
Nitrogen	30-50%	Immobilization,Volatilization,Denitrification, Leaching
Phosphorus	15-20%	Fixation in soils Al-P, Fe-P, Ca-P
Potassium	70-80%	Fixation in clay-lattices
Sulphur	8-10%	Immobilization, Leaching with water
Micro nutrients (Zn,Fe, Cu,Mn, B)	1-2%	Fixation in soils

TO INCREASE NUTRIENT USE EFFICIENCY

To make correct decision of :Which nutrient element to apply, How much to each nutrient element to apply, In which manner to apply the nutrient. and Finally, When to apply.

Methods of fertilizer application



Broadcasting

Spreading fertilizer to cover the entire production area. This method is not suitable because some of nutrients e.g P and K are largely fixed in soil. It encourages weed growth, nutrient loss by plant removal occurs.

Topdressing

Mixing fertilizer uniformly into the top one to two inches of growing media around the plant.The top dressed fertilizer should reach the root zone without root damage. For N, top dressing is effective.

Plough sole placement

In this method, fertilizer is placed at the bottom of the plough furrow in continuous band during the process of ploughing. This method has been recommended in areas where the soil becomes quite dry up to a few inches below the soil layer.

Deep placement

It is a placement of ammonical nitrogenous fertilizers in the reduction zone of soil particularly paddy fields where ammonical nitrogen remains available to the crops.

Effect of deep placement on NUE

Treatment	% of N used of total N
Broadcast in surface	24-45
8-10 cm deep	68

Localized placement

It refers to the application of fertilizers into the soil close to the seed or plant in order to supply the nutrients in adequate amounts to the root of growing plants. Localized placement is usually employed when relatively small quantities of fertilizers are to be applied. Localized placement reduces fixation of P and K. Placing a band of fertilizer near the soil surface and to the sides after seedlings emerge from the soil.

Figure 1: (b) Deep placement

Figure(a): Plough sole placement

Fig: (c) Sidedressing

Banding

Fertilizer is placed in band at a depth of 5.5-7 inches at before planting. Also fertilizers may be applied 1-2 inches below the seeds or 1-3 inches to the side of seeds. It is most effective in dry land cultivation. it is effective in high P fixing soils. DO NOT place below the seeds because fertilizer will burn the roots.

Hill placement

It is practiced for the application of fertilizers in orchards. In this method, fertilizers are placed close to the plant in bands on one or both sides of the plant.

Row placement

When the crops like sugarcane, potato, maize, cereals etc. are sown close together in rows, the fertilizer is applied in continuous bands in the row which is known as row placement.

Pellet application

It refers to the placement of fertilizer, especially N in the form of pellets in 2.5 to 5 cm to the lowland rice to avoid the N loss. The fertilizer is mixed with the soil in the ratio of 1:10 and made small pellet of convenient size placed in the reduced zone of paddy fields.

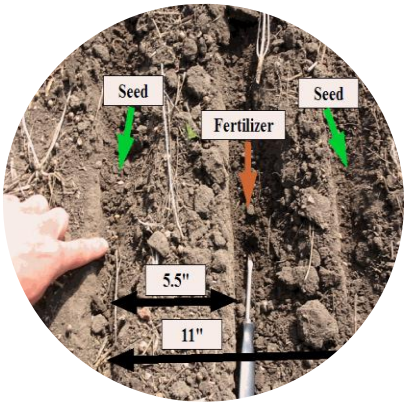
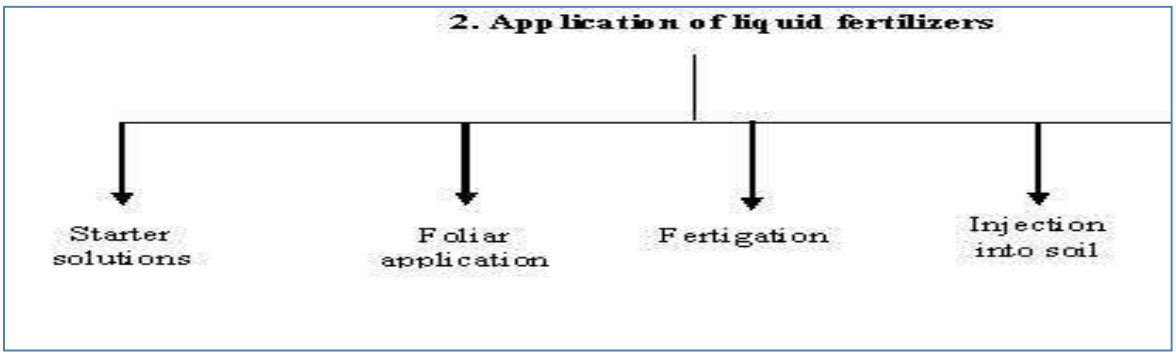


Fig: (d) Banding


Fig: (e) Hill placement


Fig: (f) Row placement



Starter solution/Pop-up fertilizers

In this method, solutions of fertilizers, generally prepared in low concentration. It consists of N, $P_2O_5$and K_2O in the ratio of 1:2:1 and 1:1:2 are applied for soaking seed, dipping roots or spraying on seedlings for early establishment and growth . so that the nutrients reach the plant roots immediately.

Foliar Spraying

It is generally applied into the broad leaf plants. Spraying micronutrients in a solution directly on the plant leaves. Foliar application does not result in a great saving of fertilizer but it may be used to quickly correct visual symptom of nutrient deficiencies, but if fertilizer concentration is too high, leaf burning will occur.

Effect of foliar application of 2%DAP, 1%K, 200ppm NAA on Yield and growth of black gram.

Samples	Growth Parameters			Yield Parameters			
	Dry matter content	Height	No. of Leaves	No. of fruits	Pod length	No. of Seeds/pod	Wt.of Seed in 1mg/g
T1	17.0	12.28	15	5	3.4	4	40
T2	21.66	15.75	19	7	3.6	5	50
T3	20.33	14.5	17	10	4.1	5	50
T4	19.5	13.99	12	13	4.4	6	60
T	21.5	14.0	13	14	4.4	6	60
T6	19.0	14.26	12	16	4.5	7	70

T1 – Water (Control), T2 – 2% DAP, T3 – 1%K, T4 – 200ppm NAA, T5 – 2% DAP + 1% K+200 ppm NAA, T6 – 1%K +200ppm NAA.

(Source: Wudpecker journal of agricultural research vol. 2(7),pp. 206-208,july 2013)

Fertigation

EFFECT OF FOLIAR APPLICATION ON YIELD AND GROWTH OF BLACK GRAM

The term fertigation is derived from fertilizer and irrigation.Fertigation is the application of fertilizer (solid and liquid) along with irrigation. The fertilizers applied from the drip irrigation system and sprinkler irrigation system. N can efficiently applied through fertigation usually Ammonium nitrate. If the conc. of Ca++, Mg++ and HCO^{3-} ion is high in irrigation water, they precipitated In the form of Ca and Mg and cause the plugging in irrigation equipment.

Injection INTO soil

It is a deep placement of fertilizers. In this method Anhydrous ammonia must be placed in narrow furrows at a depth of 12-15 cm covered immediately to prevent loss of ammonia. The soil should be well tilled and moist so that the injected NH_3 dissolved in the soil water to form Ammonium hydroxide. If the place of injection is dry NH_3 gas concentrated to raise soil pH to 9.5 hence NH_3 volatilization occurs to cause considerable loss of N.

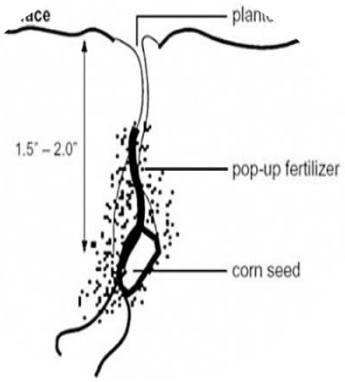


Fig: (g) Starter solution Fig: (h) Foliar spray Fig: (i) Fertigation

Different methods of phosphorus application and their affect on yield

Effect of different rates and methods of phosphorus application on grain yield (tons ha^{-1}) of mungbean

P rates (kg ha^{-1})	Broadcast	Banding	Fertigation
0	0.71	0.69	0.72
40	0.96	1.10	1.36
80	1.41	1.61	1.78
120	1.90	2.03	2.21
Mean	1.25	1.36	1.52

(Source : Soil & environ. 25 (1): 55-58, 2006)

MANAGEMENT PRACTICES TO ENHANCE NUE

A. Use of nitrification inhibitors: Inhibiters decrease the activity of nitrifying bacteria. Nitrification inhibitor used in field-

1. Oxamide- 31% N, solubility is 0.4g/liter of water.
2. Thiourea- 36.8% N
3. Nitrapyrin
4. Sulphathiazole

B. Use of slow release nitrogen fertilizers: To overcome the problem of leaching the solubility of nitrogen fertilizer are reduced by-

(a) Synthesizing compounds which are inherently less soluble eg.

1) Isobutylidene diurea :- 31-32%N
2) Crotonylidene diurea :- 32.5%N
3) Ureaformaldehyde :- 38-42%N
4) Oxamide

(b) Coating barrier to the presently available fertilizer.

1) Sulphur coated urea
2) Neem coated urea

Sulphur coated urea: In case of sulphur coated urea it oxidized by sulphur oxidizing organism to sulphuric acid. As a result acidity increasing and reduced activity of the nitrifying bacteria. Thus the rate of nitrification is controlled and nitrogen loss as nitrate is minimized.

Neem coated urea: In addition of neem cake or neem oil contains, alkaloids which inhibit the activity of the nitrifying bacteria. because the presence of the sulphur rich fatty acid in neem cake have nitrification inhibition property which altimetry decreased the loss of nitrogen the leaching.

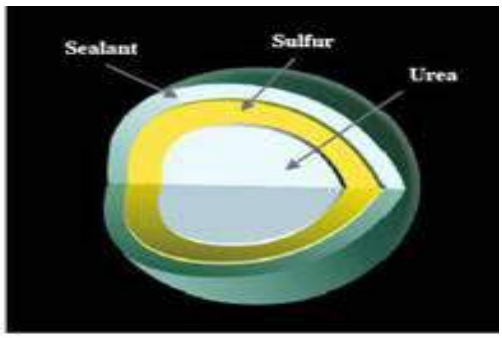


Fig: (j) Suiphur coated urea

Fig: (k) Neem coated urea

Effect of sulphur and neem coated urea on yield of rice crop compare to non coated urea

Treatment	Yield (q/ha)
Non coated urea	35
Sulphur coated urea	50
Neem coated urea	50

(Source: Tiwari K.N. Fertilizer and manure ICAR book)

LEAF COLOR CHART

The LCC is a inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant nitrogen status.LCC is a visual and subjective indicator of plant N deficiency. LCC is made of high quality plastic materials (20*7.5 cm). It is Simple alternative of chlorophyll meter/SPAD meter (soil plant analysis development).

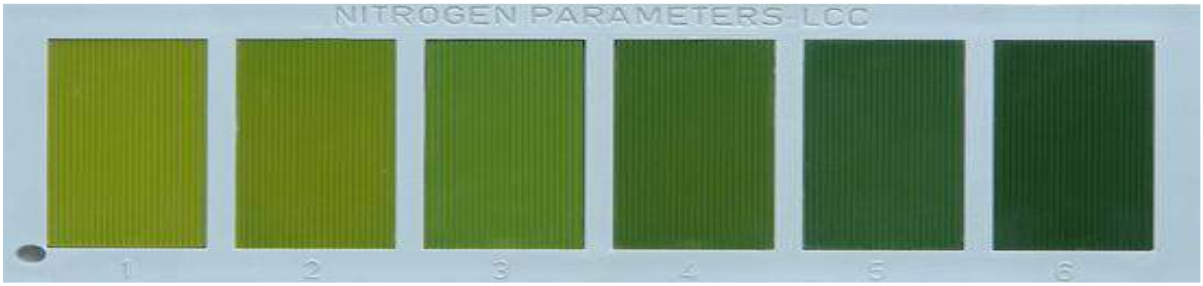


Fig: (l) Six panel leaf color chart

It consists of 6 panels color shades ranging from light yellowish green(no. 1) to dark yellowish green(no.6) color stripes fabricated with veins resembling those of rice leaves.LCC reading start at 14 DAT (TPR) or 21 DAS (DSR).Reading are taken once every 7-10 days until the 1st flowering.

HOW TO USE THE LEAF COLOR CHART

Randomly selected at least 10 disease rice plants in a field.Select topmost fully expanded leaf from plant. Place the middle part of the leaf on a chart and compare the leaf color with the color panels of LCC. Measure the leaf color under the shade of your body. Determine the average LCC reading for the selected leaves.

N dose according to critical LCC value for different season rice crop

Season	Crop	LCC critical value	N (kg/ha)	Urea (bag/ha)
Kharif	Basmati rice	4	28	1.25
	Non basmati rice	3	23	1
Rabi	Boro rice	4	35	1.5

(Source: http;//www.nitrogenmeters.com/paddy:html)

CONCLUSION

In the method of fertigation, its NUE is 90% so that it can be concluded that Fertigation is an effective method of applying chemicals and fertilizers plants via existing irrigation system and the extra activities involved in the separate application of fertilizers to are no longer necessary , neither is the purchase of maintenance of dedicated equipment for fertilizer distribution. The efficiency of foliar application is 4 to 5 times greater than the soil application methods. It does not result n greater saving of fertilizers but it may be used to quickly correct visual symptoms of nutrient deficiency.Deep placement method is also the best application method for ammonical nitrogenous fertilizers , It reduced the losses of ammonia volatilization.

Role of potassium in plants

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Potassium (K) is an essential nutrient for plant growth and is classified as a macronutrient due to large quantities of K being taken up by plants during their life cycle. A unique aspect of K is that it is not a part of any structural component of plants and as a soluble ion in the plant sap, it is required to activate at least 60 plant enzymes. Potassium plays an essential role in photosynthesis and metabolism of plants. It is important in carbohydrate breakdown which furnishes energy for plant growth. Potassium also increases drought resistance in plants and aid in reducing plant water loss.

INTRODUCTION

Potassium is an essential plant nutrient and is required in large amounts for proper growth and reproduction of plants. Potassium (K+) is the predominant inorganic ion of plant cells where it can contribute up to 10% of the dry mass. K+ is recognized as a rate-limiting factor for crop yield and quality. It plays a major role as stabilizer in metabolism and as an osmotic contributing to cellular hydrostatic (turgor) pressure, growth and responses to environmental changes. A high and relatively stable potassium concentration in certain cell compartments is important for enzyme activation, stabilization of protein synthesis, neutralization of negative charges on proteins, formation of membrane potential in cooperation with the proton motive force, and maintenance of cytosolic pH homeostasis. Potassium is considered second only to nitrogen, when it comes to nutrients needed by plants, and is commonly considered as the "quality nutrient."

FUNCTIONS OF POTASSIUM

Potassium plays many important regulatory roles in development. Potassium (K) increases crop yield and improves quality. It is required for numerous plant growth processes.

Enzyme Activation

Enzymes serve as catalysts for chemical reactions, being utilized but not consumed in the process. They bring together other molecules in such a way that the chemical reaction can take place. Potassium "activates" at least 60 different enzymes involved in plant growth. The K changes the physical shape of the enzyme molecule, exposing the appropriate chemical active sites for reaction. Potassium also neutralizes various

organic anions and other compounds within the plant, helping to stabilize pH between 7 and 8...optimum for most enzyme reactions. The amount of K present in the cell determines how many of the enzymes can be activated and the rates at which chemical reactions can proceed. Thus, the rate of a given reaction is controlled by the rate at which K enters the cell (Van Brunt and Sultenfuss, 1998).

Stomatal Activity (Water Use)

Plants depend upon K to regulate the opening and closing of stomata. The pores through which leaves exchange carbon dioxide (CO_2), water vapor, and oxygen (O_2) with the atmosphere. Proper functioning of stomata is essential for photosynthesis, water and nutrient transport, and plant cooling. When K moves into the guard cells around the stomata, the cells accumulate water and swell, causing the pores to open and allowing gases to move freely in and out. When water supply is short, K is pumped out of the guard cells. The pores close tightly to prevent loss of water and minimize drought stress to the plant (Thomas and Thomas, 2009). If K supply is inadequate, the stomata become sluggish slow to respond and water vapor is lost. Closure may take hours rather than minutes and is incomplete. As a result, plants with an insufficient supply of K are much more susceptible to water stress. Accumulation of K in plant roots produces a gradient of osmotic pressure that draws water into the roots. Plants deficient in K are thus less able to absorb water and are more subject to stress when water is in short supply.

Photosynthesis

The role of K in photosynthesis is complex. The activation of enzymes by K and its involvement in adenosine triphosphate (ATP) production is probably more important in regulating the rate of photosynthesis than is the role of K in stomatal activity. When the sun's energy is used to combine CO2 and water to form sugars, the initial high-energy product is ATP. The ATP is then used as the energy source for many other chemical reactions. The electrical charge balance at the site of ATP production is maintained with K ions. When plants are K deficient, the rate of photosynthesis and the rate of ATP production are reduced, and all of the processes dependent on ATP are slowed down. Conversely, plant respiration increases which also contributes to slower growth and development. In some plants, leaf blades re-orient toward light sources to increase light interception or away to avoid damage by excess light, in effect assisting to regulate the rate of photosynthesis. These movements of leaves are brought about by reversible changes in turgor pressure through movement of K into and out of specialized tissues similar to that described above for stomata (Van Brunt and Sultenfuss, 1998).

TRANSPORT OF SUGARS

Sugar produced in photosynthesis must be transported through the phloem to other parts of the plant for utilization and storage. The plant's transport system uses energy in the form of ATP. If K is inadequate, less ATP is available, and the transport system breaks down. This causes photosynthates to build up in the leaves, and the rate of photosynthesis is reduced. Normal development of energy storage organs, such as grain, is retarded as a result. An adequate supply of K helps to keep all of these processes and transportation systems functioning normally (Van Brunt and Sultenfuss, 1998).

WATER AND NUTRIENT TRANSPORT

Potassium also plays a major role in the transport of water and nutrients throughout the plant in the xylem. When K supply is reduced, translocation of nitrates, phosphates, calcium (Ca), magnesium (Mg), and amino acids is depressed (Schwartzkopf, 1972). As with phloem transport systems, the role of K in xylem transport is often in conjunction with specific enzymes and plant growth hormones. An ample supply of K is essential to efficient operation of these systems (Thomas and Thomas, 2009).

PROTEIN SYNTHESIS

Potassium is required for every major step of protein synthesis. The "reading" of the genetic code in plant cells to produce proteins and enzymes that regulate all growth processes would be impossible without adequate K. When plants are deficient in K, proteins are not synthesized despite an abundance of available nitrogen (N). Instead, protein "raw materials" (precursors) such as amino acids, amides and nitrate accumulate. The enzyme nitrate reductase catalyzes, the formation of proteins and K is likely responsible for its activation and synthesis (Patil, 2011).

STARCH SYNTHESIS

The enzyme responsible for synthesis of starch (starch synthetase) is activated by K. Thus, with inadequate K, the level of starch declines while soluble carbohydrates and N compounds accumulate. Photosynthetic activity also affects the rate of sugar formation for ultimate starch production. Under high K levels, starch is efficiently moved from sites of production to storage organs (Patil, 2011).

Crop Quality

Potassium plays significant roles in enhancing crop quality. High levels of available K improve the physical quality, disease resistance, and shelf-life of fruits and vegetables used for human consumption and the feeding value of grain and forage crops. Fiber quality of cotton is improved. Quality can also be affected in the field before harvesting such as when K reduces lodging of grains or enhances winter hardiness of many crops. The effects of K deficiency can cause reduced yield potential and quality long before visible symptoms appear. This "hidden hunger" robs profits from the farmer who fails to keep soil K levels in the range high enough to supply adequate K at all times during the growing season.

Potassium Uptake

Bio-availability and uptake of K by plants from the soil vary with a number of different factors. The rate of respiration by plants is largely the determining factor for proper uptake and transport of potassium by plants. Its uptake is dependent on sufficient energy (ATP). Potassium plays a vital role in the trans-location of essential nutrients, water, and other substances from the roots through the stem to the leaves. It is also made available through fertilizers in the form of K_2O. Plant tissues analyze the form in these fertilizers and convert it in a more bio-available form. It is absorbed in the form of ions- K^+.

POTASSIUM UPTAKE BY PLANTS IS AFFECTED BY SEVERAL FACTORS

Soil Moisture: Higher soil moisture usually means greater availability of K. Increasing soil moisture increases movement of K to plant roots and enhances availability. Research has generally shown more responses to K fertilization in dry years.

Soil Aeration and Oxygen Level

Air is necessary for root respiration and K uptake. Root activity and subsequent K uptake decrease as soil moisture content increases to saturation. Levels of oxygen are very low in saturated soils.

Soil Temperature: Root activity, plant functions, and physiological processes all increase as soil temperature increases. This increase in physiological activity leads to increased K uptake. Optimum soil temperature for uptake is 60-80°F. Potassium uptake is reduced at low soil temperatures.

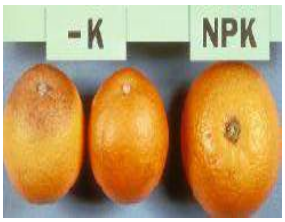
Tillage System: Availability of soil K is reduced in no-till and ridge-till planting systems. The exact cause of this reduction is not known. Results of research point to restrictions in root growth combined with a restricted distribution of roots in the soil.

Potassium deficiency in plants

Potassium deficiency might cause abnormalities in plants, usually the symptoms are growth related.

Potassium deficiency symptoms

Potassium deficiency in banana



Potassium deficiency in citrus

Potassium deficiency in potato

Cholrosis – scorching of plant leaves, with yellowing of the margins of the leaf. This is one of the first symptoms of Potassium deficiency. Symptoms appear on middle and lower leaves.

Slow or Stunted growth - as potassium is an important growth catalyst in plants, potassium deficient plants will have slower or stunted growth.

Poor resistance to temperature changes and to drought – Poor potassium uptake will result in less water circulation in the plant. This will make the plant more susceptible to drought and temperature changes.

Defoliation - left unattended, potassium deficiency in plants results in plants losing their leaves sooner than they should. This process might become even faster if the plant is exposed to drought or high temperatures. Leaves turn yellow, then brown and eventually fall off one by one.

Poor resistance to pests- K-deficient plants tend to be more susceptible to infection than those with an adequate supply of K. Use of K significantly decreased the incidence

of fungal diseases by 70%, bacteria by 69%, insects and mites by 63%, viruses by 41% and nematodes by 33%.

PREDICTING THE NEEDS FOR POTASH

The K status of soils can be monitored with either plant analysis or routine soil testing procedures. Plant analysis can be used to either confirm a suspected deficiency indicated by visual symptoms or routinely monitor the effects of a chosen fertilizer program. An interpretation for K levels in plant tissue is provided in Table 1.

If amounts of K in the root zone are more than enough to meet crop needs, K will be absorbed by plants in amounts higher than required for optimum yield. This can lead to higher than normal concentrations of K in plant tissue and is referred to as "luxury consumption." Luxury consumption has no known negative effect on plant growth and yield. Plant analysis is a management tool that can be used to look back at nutrient supplies during the growing season. This tool cannot be used to predict the amount of potash needed for any crop in the next growing season.

Table 1. Sufficiency levels of potassium for major agronomic crops, vegetables, and fruit

Crop	Plant part	Time	Sufficiency range (% K)
Alfalfa	Tops (6" new growth)	Prior to flowering	2.0-3.5
Apple	Leaf from middle of current terminal shoot	July 15 - August 15	1.2-1.8
Blueberry	Young mature leaf	First week of harvest	0.4-0.7
Broccoli	Young mature leaf	Heading	2.0-4.0
Cabbage	Half-grown young wrapper leaf	Heading	3.0-5.0
Carrot	Young mature leaf	Mid-growth	2.8-4
Cauliflower	Young mature leaf	Buttoning	2.6-4.2
Corn	Whole tops	Less than 12" tall	2.5-3.5
Edible bean	Most recently matured trifoliate	Bloom stage	1.5-3.3
Grape	Petiole from young mature leaf	Flowering	1.5-2.0
Soybean	Trifoliate leaves	Early flowering	1.7-2.5
Spring wheat	Whole tops	As head emerges from boot	1.5-3.0
Strawberry	Young mature leaf	Mid-August	1.1-2.5
Sweet corn	Ear leaf	Tasseling to silk	1.8-3.0
Sugar beet	Recently matured leaves	50-80 days after planting	2.0-6.0

Source: Bryson et al. (2014)

The soil test for K is the best management tool for predicting the amount of potash needed in a fertilizer program. Available K in soils is estimated by measuring the total of

solution K (water = soluble K) and exchangeable K. The definitions for the relative levels of soil test K are summarized in Table 2.

The relative level classifications represent an estimation of the soil's ability to supply all the needed K for a crop. An increase in production can be expected if potash fertilizer is added to the fertilizer program when soil test values are in the low and very low ranges. Added yield may or may not be observed if potash is added when the soil test values are in the medium range or greater. A response to potash fertilization should not be expected if soil test values for K are in the high or very high range.

Table 2. Rating chart of soil test values for k for Indian soil for air-dried soil samples.

Soil test potassium (kg/ha)	Rating
< 108	low
108-280	medium
>280	high

CONCLUSION

Potassium is extremely important in many ways to the productivity of plant. The need for potash in a fertilizer program can be determined from plant analysis and soil testing. Soil testing is the most reliable predictor of this need.

REFERENCES

Bryson et al. (2014), Plant Analysis Handbook III; Rosen and Eliason (2002), Nutrient Management for Commercial Fruit and Vegetable Crops in Minnesota.

Patil RB(2011). Role of potassium humate on growth and yield of soybean and black gram. *International Journal of Pharma and Bio sciences* 2(1) 242-246.

Schwartzkopf C (1972). *Potassium, calcium, magnesium- how they relate to plant growth* mid-continent agronomist, us green section role of potassium in crop establishment from agronomists of the potash & phosphate institute.

Thomas TC and Thomas AC (2009). Vital role of potassium in the osmotic mechanism of stomata aperture modulation and its link with potassium deficiency. *Plant Signal Behaviour* 4(3) 240–243.

Van Brunt JM and Sultenfuss JH(1998). Better crops with plant food. In *Potassium: Functions of Potassium* 82(3) 4-5.

Seed coating: Quality enhancement technique for seed

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Abstract

Maintenance of seed vigour and viability during storage is a matter of prime concern. In storage, the viability and vigour of the seeds not only vary from genera to genera and variety to variety, but it is also regulated by many physiological factors like moisture content, atmospheric relative humidity, temperature, initial seed quality, physical and chemical composition of seed, gaseous exchange, storage structure, packaging materials, seed production location and techniques. To maintain the viability and vigour, the seeds are given various quality enhancement treatments before storage and sowing. Among these, seed coating is one of the techniques where seeds are coated with materials viz., polymers, fungicides and insecticides are applied directly on the seed to enhance its quality and production potential without significantly increasing the size or weight of the seed and obscuring the seed shape. This technology has developed rapidly during the past two decades and provides an economical approach to seed enhancement for quality seed production in various agricultural and horticultural crops like Maize, Onion, Carrot, okra, Cotton etc. An advantage of seed coating is that the seed enhancement material (Polymer, fungicide and insecticide) are coated directly on the seed without altering the shape of the seeds. Seed coatings with natural or synthetic polymers have gained rapid acceptance by the seed industry as a much safer coating material.

INTRODUCTION

Seed is a carrier of new technology and the basic input in agriculture upon which other inputs are applied. Agricultural practices begin and end with seed. So, high quality seed is the key mandatory for successful agriculture. A good energetic seed utilizes all the resources and gives a realistic output to the grower. It is wealth of the farmer, it is yesterday's harvest and tomorrows hope. Modern high-tech agriculture with its modern technology demands that each and every seed material should readily germinate and produce a vigorous seedling for ensuring high marketable yield. Seed coating is the substance applied to the seed that does not obscure its original shape and size with a minimal weight gain. Seed coating materials, *viz*., polymers, fungicides and insecticides are applied directly on the seed to enhance its quality and production potential without significantly increasing the size or weight of the seed and obscuring the seed shape (Kumar et al., 2007). The polymer film may act as physical barrier, which has been

reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo. Smaller amounts of chemicals are needed as compared to broadcasting. The field thinning operation is faster, cheaper, and more accurate when coated seeds are used. The objective of coating is to deliver the seed in a form that is larger, rounder, smoother, heavier and more uniform than the original seed.

IMPORTANCE OF SEED COATING

Seed is coated when growers need a precision-sown crop and the non-coated seed is too small, light, or variable in size or shape to be sown accurately with existing equipment. Polymer coating makes sowing operation easier due to the smooth flow of seeds. Addition of colourant helps in visual monitoring of placement accuracy, enhance the appearance, marketability and consumer preference. Precision sowing is desirable when growers need singulation, e.g., for cell tray plant production in a greenhouse or strict control of spacing or depth of placement (e.g., onion spacing is critical to achieve desired bulb size at harvest). Singulation and controlled spacing also are vital for crops that are direct-sown and then thinned back to the desired plant population. By encasing the seed within a thin film of biodegradable polymer, the adherence of seed treatment to the seed is improved, ensures dust free handling, make treated seed both useful and environment friendly. Seed coating helps in improving the resistance of seeds towards pest and diseases in the much warranted juvenile stage, besides improves the seedling vigour. The polymer coat provides protection from the stress imposed by accelerated ageing, which includes fungal invasion. The polymer coating is simple to apply, diffuses rapidly and is also non-toxic to the seed during germination. It reduces chemical wastage, protect the nutrients, oxygen suppliers and protect seed from fungal invasion and insects attack. By encasing the seed with thin film of biodegradable polymer, the adherence of seed treatment to the seed improves, ensures dust free handling and make treated seed both useful and environment friendly. Seed coating technology has developed rapidly during the past two decades and provides an economical approach to seed enhancement. An advantage of seed coating is that the seed enhancement material (fungicide and insecticide) is placed directly on the seed without obscuring the seed shape.

SEED COATING MATERIALS

Seed are coated with polymer, fungicides, insecticides, micro and macro nutrients etc. Adhesives which are used for pelleting can be used. The polymer used should not degrade when exposed to heat or humidity, should be environmentally safe, non-toxic to plants and does not inhibit germination**.** Solvents or diluents such as water, fevicol or any other organic solvents can be used. Equipments like pelleting pan or fluidized bed seed – coating apparatus are commonly used.

TYPES OF SEED COATING

Seed film coating: Film coating involves application of liquid to seed but does not obscure its shape and seed weight to a larger extent however it may increase up to 10 %. Film coating provides seed with high flow ability, protection from pathogens and

better appearance of seed. It provides excellent medium to carry pesticides, biological and micronutrient substances to improve crop stand, binder and carrier for actives (pesticides & fungicides). Seed coating with polymer acts as temperature switch and protective coating by regulating the seed coating, intake of water until the soil has warmed to a predetermined temperature. It enables accurate and even doses of chemicals and reduces chemical wastage and also makes room for including all the required ingredients like inoculants, protectants, nutrients on the seeds. The film coated seeds reduce imbibition damage and improve germination and seed storage period will increase without loss of viability. Seed film coating is used for many horticultural crops such as onion, lettuce, okra and in some high volume crop like maize, sorghum, cotton etc. for applying the insecticides and pesticides directly on the seeds. The polymer film may act as physical barrier, which has been reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo (Vanagamudi et al. 2003). Basavaraj et al. (2008) found Polymer film coated Onion seeds with polymer @ 12 ml + Thiram @ 2 g/kg of seeds recorded higher germination, vigour index, dry weight of seedlings and lower seed infection and electrical conductivity.

Fig. Film coated Marigold, Maize and Pumpkin seeds

Seed pelleting: Pelleting, an another magnificent technique, is normally used in case of irregular shaped seed e.g. okra seeds or for extremely small seeds (onion seeds) so as to achieve uniform shape, which makes sowing efficient and uniform. It is the process of enclosing a seed with a small quantity of inert material just large enough to facilitate planting. Pelleted materials like clay, limestone, calcium carbonate, growth regulators, vemiculiteare (fillers) and adhesive materials such as gum Arabic, gelatin, methyl cellulose etc. along with inoculants are applied in such a way that they affect the seeds or soil at the seed soil interference (Halmer, 2006). These fillers and adhesive materials create natural water holding media and provide small amount of nutrients to younger seedlings. e.g. carrot. Evlakova (1985) found that pelleting of delinted cotton seeds with carboxymethyl cellulose polymer film increased germination by 24.50 per cent compared to untreated seeds.

Fig: Seed pelleting in carrot

Seed colouring: Seeds colouring with different naturally colouring dyes and artificial chemical dyes in order to enable brand identification and to give the seed a distinct and attractive look. Seed colouring is also an enhancement technique mainly done to improve its marketability, brand identity and to enable the farmers for easy identification of the varieties based on colour. It also acts as insect and bird repellant. Natural and synthetic dyes are used commonly used for colouring. e.g. Beetroot, opuntia, turmeric (natural dyes) copper sulphate, bromocresol green, congo red, turquoise blue, rhodomine – B and potassium permagnate (synthetic dyes).

CONCLUSION

Seed management is an inevitable practice for successful crop production. Seed coatings are seen as one way in which seedlings may have an improved 'competitive ability' conferred upon them. In crop establishment early seedling growth is of great importance in obtaining optimum plant stands and maximizing yields. It is a foremost technology in precision agriculture in present days as there is increase in accuracy and effectiveness of crop protection product by limiting the application rate of pesticides. Future research may be more focused on advanced physical (microwave, ultrasound, ozone treatment) and biological (biopriming) methods of treating seeds alternative to chemical seed treatment. Advances in seed treatment technology will refine existing treatment strategies and future research should be focused on biological seed treatments in addition to chemical treatment using microbial inoculants. At last, it can be concluded that seed treatment must be an preliminary step of raising crop and has a essential role in sustainable crop production which cannot be ignored.

REFERENCES

Basavaraj BO, Patil NKB, Vyakaranlal BS, Basavaraj N, Channappagoudar BB and Hunje R. 2008. Effect of fungicide and polymer film coating on storability of onion seeds. *Karnataka Journal of Agricultural Science* 21: 212-218

Evlakova ES. 1985. Effect of concentration of physiologically active compounds on germination of pelleted cotton seeds. *Materially-republicans-koi-nauchno teoreticheskoi konferenstsil molodykh - uchenykh - i - spectsialistov tadzhikskoi SSR - sektsiya - biology* 35: 50-55

Kumar J, Nisar K, Kumar MBA, Walia S, Shakil NA, Prasad R and Parmar BS. 2007. Development of polymeric seed coats for seed quality enhancement of soybean (*Glycine max* L.). *Indian Journal of Agricultural Sciences* 77: 738-743

Sherin and John S. 2003. Seed film coating technology using polykote for maximizing the planting value, growth and productivity of maize. MSc. (Agriculture) Thesis, Tamilnadu Agriculture. University, Coimbatore (India).

Vanangamudi K, Srimathi P, Natarajan N and Bhaskaran M. 2003. Current scenario of seed coating polymer. *ICAR* - Short Course on Seed Hardening and Pelleting Technologies for Rain Fed or Garden Land Ecosystems P 80-100

Canine Cholelithiasis and its therapeutic management

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Abstract

Cholelithiasis, an extrahepatic biliary obstruction disease of animals, related to cholesterol metabolism is an incidental finding in small animals during ultrasonography or at post-mortem. Choleliths are formed by combination of calcium salt, unconjugated bilirubin and phospholipids. Depending on the pigmentation and composition choleliths have been classified and sub classified into several types. Clinical findings in cholelithiasis may include anorexia, vomition, jaundice, fever etc. The diagnosis of the cholelithiasis may be done by blood tests and supportive imaging techniques. Antibiotics, vitamins and in certain cases surgical intervention is necessary for the treatment of cholelithiasis with certain preventive measures to prevent its occurrence.

INTRODUCTION

Cholelithiasis is a common form of extrahepatic biliary obstruction in dogs which is an incidental finding on ultrasonography or at post-mortem. Most choleliths are clinically silent in dogs and cats but common in middle-aged to older animals and in small-breed dogs. Bile is composed of 70% bile salt and acid, 10 % cholesterol, 5 % phospholipids, 5% protein, 1 % conjugated (Direct) and unconjugated (indirect) bilirubin and water. Bile Salts, the products of cholesterol metabolism, have both hydrophilic and hydrophobic groups making them amphiphilic. Amphiphilic substances like phospholipids and bile salts help in the solubilisation of cholesterol for transport through body fluids. Any abnormalities in the above concentration may result in the formation of gall stone.

Type of gall stone/ Choleliths:

Generally 2 type of gall stone are found

1. Cholesterol stone
2. Pigmented stone: It is of 2 types

i. Back pigmented stone
ii. Brown pigmented stones

1. Cholesterol stone:

Cholesterol stone is the common form of gall stone comprising around 75-90% of all stone cases (fig.1). This type of stones are generally observed in Hypercholesteremia or precipitation of the cholesterol due to low Phospholipid or bile salt content in body or gall bladder stasis by gravity resulting in accumulation of cholesterol on top of the bile and supersaturate to form the stone. This is usually not observed in X-ray but may be visible when it combines with calcium carbonate ($CaCO_3$).

Fig.1: Cholesterol stone

2. Pigmented Stone:

Pigmented stones are generally formed by combination of bilirubin and calcium-carbonate. Bilirubin in the bile is comprised of 98-99% conjugated bilirubin (CB) and negligible i.e. 1-2% unconjugated bilirubin (UCB). This Pigmented stone is formed by the unconjugated bilirubin which is visible on X-Ray.

There are 2 types of pigmented bilirubin. i.e.

i) Black Pigmented Gall stone:

It is observed due to high extravascular haemolysis. High extravascular haemolysis results in production of more amount of UCB which combines with calcium salt to form calcium bilirubinate stone (Fig.2).

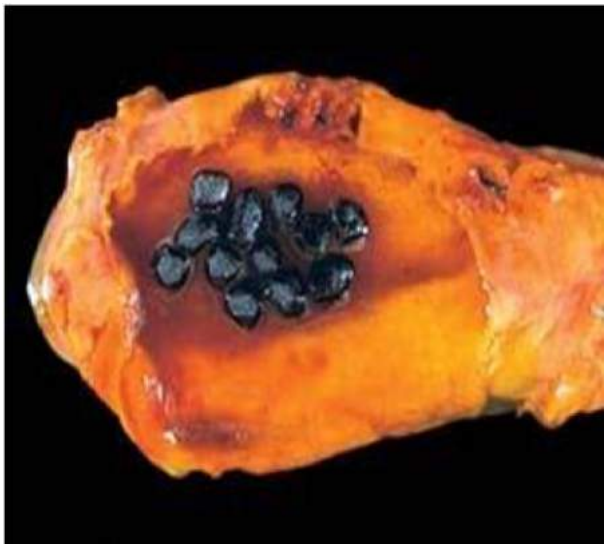

Fig.2: Black pigmented gall stone

ii) Brown pigmented gall stone:

This is associated with bacterial infections resulting in biliary stasis. Hydrolytic enzymes produced as a result of bacterial invasion causes hydrolysis of CB to UCB and hydrolysis of phospholipid. Unconjugated bilirubin with Calcium ion and hydrolysed phospholipid results in formation of brown gall stones (Fig.3).

Fig.3: Brawn pigmented gall stone

CLINICAL FINDINGS

Cholelithiasis may be associated with vomition, anorexia, jaundice, fever, and abdominal pain. However, in many animals remain asymptomatic or display postprandial discomfort (e.g. stretching, position of relief, changing postures, wandering etc.).

DIAGNOSIS

Diagnosis is usually based on clinical history and supportive imaging studies (usually ultrasonography). In Gall stone blood tests usually shows leucocytosis, hypoalbuminemia, hypercholesterolemia, elevated bilirubinemia, high γglutamyl transferase (GGT), Alanine transaminase (ALT) and Aspartate transaminase (AST).

Ultrasonography can detect stones >2 mm in diameter in the gallbladder; however, both skill and luck are needed to recognize stones lodged in segments of the common bile duct or in the hepatic bile ducts. Biopsy and culture of liver tissue is necessary to identify underlying disease processes and associated bacterial infections in animals with small duct cholelithiasis,

TREATMENT

- Medical treatment of Cholelithiasis includes
  - Broad-spectrum antibiotics (Enrofloxacin and Metronidazole),
  - Ursodeoxycholic acid at 15–25 mg/kg, PO, divided bid and given with food,
  - S-adenosyl Methionine (Heptral, Biosam, SAMe) at 20–40 mg/kg/day, PO, on an empty stomach ,
  - Vitamin E at 10 U/kg/day can be used for its antioxidant and anti-inflammatory effects.
- Surgical intervention is necessary if choleliths are associated with cholecystitis causing cystic duct obstruction, or occluding the common bile duct. Successful treatment of cholecystitis and cystic duct occlusion requires cholecystectomy and lavage of the common bile duct.

- **Cholecystectomy:**
  - The gall bladder can be removed in dogs and a normal life span can be expected (as is the case in humans)
  - Indications to remove a gall bladder
    - Rupture of the gall bladder due to trauma or from obstruction of the common bile duct due to stones or congealed bile.
    - Tumour of the gall bladder
- **Cholecysto-duodenostomy:**
  - This procedure involves dissecting the gall bladder off of the liver, making a hole in the gall bladder and sewing it to a hole made in the small intestine which allows bile to flow from the liver to gall bladder, then directly to the intestine. Thisin essence is a by-pass for bile so that it no longer needs to flow through the common bile duct.
  - **Indications for Cholecysto-duodenostomy**
    - Constricted common bile duct which does not allow bile to pass through to the intestine
    - Tumour of the common bile duct
    - Pancreatitis which causes the common bile duct to swell

PREVENTION AND CONTROL

For prevention and control of cholelithiasis, maintainace of body weight is essential which can be achieved by withholding cholesterol rich foods to animals. Estrogenic medication should be avoided as well. Daily exercise and regular health check-up of the pet animals are also essential in prevention of the disease.

CONCLUSION

Cholelithiasis can be cured by the surgical and medicinal intervention; however it can be prevented by dietary changes. Regular monitoring of the health status of the animal is essential in preventing the disease.

REFERENCES

Baker SG, Mayhew PD, Mehler SJ. 2011 Choledochotomy and primary repair of extrahepatic biliary duct rupture in seven dogs and two cats. J Small Anim Pract. 52(1):32-7

Center SA. 2009 Diseases of the gallbladder and biliary tree. Vet Clin North Am Small Anim Pract. 39(3):543-98

Kirpensteijn J, Fingland RB, Ulrich T, Sikkema DA, Allen SW. 1993. Cholelithiasis in dogs: 29 cases (1980-1990). J Am Vet Med Assoc. 202(7):1137-42.

http://medicinembbs.blogspot.in/2012/12/gallstones.html

http://www.namrata.co/gall-stones-cholesterol-metabolism-subjective-questions-set-3/

Destructive fruit fly species in cucumber and their management

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Cucumber (*Cucumis sativus*) is one of the most important cucurbit crops in India and grown on an area of 77 ha with annual production of 1246 MT (NHB, 2017). Throughout the period of growth and development, several insect- pests infest this crop. As a consequence, the quality and economic yield become a major constraint. Among all the destructive insects, fruit fly is most precarious. Several species are known to attack cucurbits but the most common are *Bactocera tau, B. cucurbitae, B. scuteleris and B. nigrofemurelis.* The extent of loss caused by these fruit flies ranges from 30 to 100 % depending on the environmental conditions. The most devastating fruit fly species of cucumber with their symptoms and management practices have been discussed in the present article.

***Bactocera cucurbitae* (Coquillett) (Diptera: Tephritidae)**

Bactrocera cucurbitae (Coquillett) also commonly known as melon flies is a major threat to cucurbits, fruits and vegetables. Melon flies are known to have more than 80 hosts. This pest is considered to be major pests of cucurbits crops including cucumber.

***Bactrocera cucurbitae* adult male**

Biology

The life cycle melon flies from egg to adult takes14-27 days.

Eggs – The eggs are white colour and slender, which measure about 1/12 inch length. Eggs are laid 2 to 4 mm deep in the fruit in a bunches of 1 to 40 and hatch in 24-28 hours.

Larvae - The larvae, are cylindrical, elongate, narrowed and 1/2 inch in length upon maturity. The larval period varies from 4 to 11 days depending on the environment.

Pupae – Pupation occur inside the soil just near the host plant. They are 1/5 to 1/4 inch long, elliptical and colour varies from white to light brown. The pupal stage lasts 7 to 13 days, depending on the temperature and host.

Adults - Adults lifespan lasts for 10 months to one year. The adult of melon flies measure 1/3 to 1/2 inches in length while wingspan is 1/2 to 3/5 inches. The head and eyes usually appear dark brown. The body colour is yellow- brown with a yellow spot just above the base of first pair of insect legs. A yellow stripe having curved lines on each side appears on the center of abdomen. Wings have a patterned with a thick brown band that extends along the edge, and have a big brown spot at the tip. Another thin band is present which extends from the wing base just inside the trailing edge of each wing. Brown spot is present near the wing margin. Abdomens are reddish-yellow and have darker bands on the second and third abdominal segments. Legs are yellowish. Female starts lay eggs in about 11-12 days after their emergence. One female can lays up to 1,000 eggs during her lifespan. Females prefer to oviposit 2 to 4 mm deep in new young, green, and tender fruits, growing tips, young seedling.

Bactrocera tau Walker (Diptera: Tephritidae)

B. tau, (Tephriditae: Ditera) is a key insect pest of cucumber production regions of the world. They are notorious pest and cosmopolitan in nature and can feed on broad host range. Some of the important hosts are melons, tomatoes. They often cause direct injury to the fruit.

***Bactrocera tau* adult male**

Biology

Eggs – Eggs are white in colour and later change to yellow-white colour, measuring about 0.8 mm long, 0.2 mm wide.

Larvae – Larval consist of three instars, and are apodous and frugivorous, white to pale yellow in colour. The larval period lasts for about 7 days depending on the environment. The first instar is almost translucent, second a nd third instars ane creamy white.

Pupae – Pupation occur in the soil beneath the host plant. They are white to yellow brown in colour and are cylindrical, brownish, rounded anteriorly, slightly out curved laterally, dorsal and ventral surface sometimes with distinct segmentation and rounded posteriorly. Pupal period last for 7 days depending on the environmental condition.

Adults - Adults generally live more than 6 months. Male and female could lives 121 to 141 days at comparatively high temperature. Adults have orange-brown scutum are black, and with lateral and medial yellow stripes; with facial spots, anterior supra alar

setae, prescutellar setae, 4 scutellar setae. Wing with costal band overlapping vein R_{2+3} and expanded apically into a spot. Male with pecten on third abdominal tergum.

1. *Bactrocera scutellaris* (Bezzi)

B. scutellaris is also one of the destructive pests of cucurbits. They not only infest the tender fruits but also infest the growing vegetative parts leading to low growth and vigour of the plant.

***Bactrocera scutellaris* adult male**

Biology

Eggs – Eggs are white in colour, elongated and centrally curved. Females usually lay eggs singly upon puncturing the young and soft rind. The size is about 1.18 mm long, 0.30 mm wide.

Larvae – The newly hatched larvae are white and later on change to pale yellow in colour. The larval period lasts for about 7 days depending on the environment.

Pupae – Pupation occur in the soil beneath the host plant. They are reddish brown in colour Pupal period last for 7-10 days depending on the environmental condition.

Adults – Adult fruit fly scutum are blackish-brown, have narrow lateral and medial yellow stripes and facial spots. The fore wings have costal band which are extended into an apical spot. The abdomen was blackish-brown with a narrow yellow band at the beginning followed by a broad yellow band. Females have long ovipositor.

2. *Bactrocera nigrofemuralis,* White & Tsuruta (Diptera: Tephritidae)

Bactrocera nigrofemoralis White & Tsuruta (Diptera: Tephritidae) were at first visually distinctive from other fruit flies on the basis of their dark colour.

***Bactrocera nigrofemoralis* adult male**

Biology

Eggs – Eggs are white in colour, elongated and centrally curved. Females lay eggs singly by puncturing the soft tissues. The size is about 1.18 mm long, 0.30 mm wide.

Larvae – The newly hatched larvae are white and later on change to pale yellow in colour. The larval period lasts for about 7 days depending on the environment.

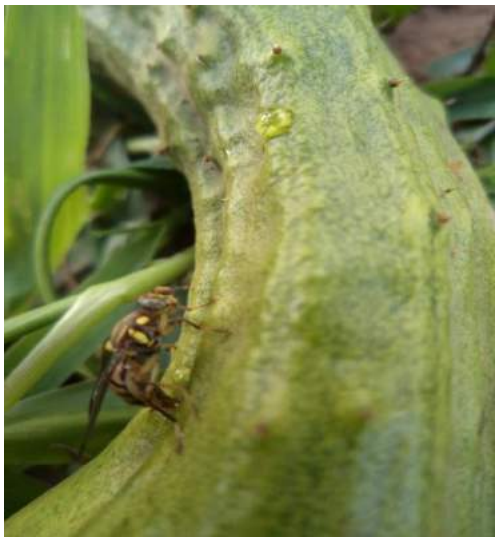
Pupae – Pupation occur in the soil beneath the host plant. They are reddish brown in colour Pupal period last for 7-10 days depending on the environmental condition.

Adults – Adult fruit fly are usually small. Thorax has blackish scutum with no pale marking. Scutellum is yellow with a moderately broad black basal band. The wings has anal streak. The abdomen was black. In Tergum I narrow brown colour band is present. Tergum III has pectin in male. In tergum V pair of oval shining black spot is present.

Damage symptom

1. Adult females flies are often select the young and soft fruit and vegetative part for oviposition site. Ovipositional punctures are usually seen as raised and brown resinous encrustation. This is because of the fruit juice that is discharge through punctures.
2. Infested fruit are deformed in shape or rotten due to secondary microbial infection.
3. The infested fruits usually show internal decay and when cut open there is foul smell.

Ovipositional puncture in young fruit



Adult female *B. tau* laying eggs in cucumber

Rotten cucumber fruit

Deformed cucumber fruit

Photographs by Yendrembam K. Devi

Management

Monitoring and mass trapping: Monitoring should be done to know the early infestation of the pests by using pheromone trap. Mass trapping of female should be

done by using protein + insecticide bait application. Mass trapping of male can be done by using parapheromone lure. Methyl eugenol and cue-lure traps are effective.

Field sanitation: It is the most important management. The infested and damaged fruits should be buried deep inside the soil.

Bagging of fruit: Bagging of the fruit should be done with 2 layers of paper bag. This will decrease the fruit fly infestation.

Crop rotation: Rotation of the crop is one of the most effective fruit fly management. Often growing of non-host crop in the next season will deprived of the host plant and due to this the insect population will reduce.

Host plant resistance: Growing of tolerant and resistant cultivar of cucurbits is one of the options to limits the fruit fly damage as compare to susceptible cultivar.

Chemical control: Application of chemical control is relatively ineffective. But application of insecticide+ attractant is very effective. MAT and BAT are very effective in reducing fruit fly population as compare to insecticide spray.

Quarantine: The spread of the fruit fly can be blocked from one place or country to another non-infested place can be done through tight quarantine.

Disease Management in Soybean

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Abstract

Soybeans are plagued by numerous diseases affecting the leaves, stems, pods and roots. Diseases as well as physiological factors often are major constraints to production. The interaction of environmental conditions, host susceptibility and the presence of virulent strains or races of pathogens all contribute to determining whether significant yield losses occur. Other factors, like cropping systems, vectors of virus diseases and seed quality may influence the occurrence of diseases. Important diseases are dry root rot, wilt, leaf spot and soybean mosaic virus. Successful disease management programs begin with correctly diagnosing the disease; use of cultural techniques consisting mainly of crop rotation, host resistance and production of high quality seeds; and the use of fungicides to control foliage and seed diseases.

INTRODUCTION

Production of soybeans in the tropics has increased over the last several decades with potential for continued growth as projects aimed at increasing production and utilization are implemented at international research centers and national research programs. To minimize losses due to field crop diseases, it is important to correctly identify the disease, so that appropriate management steps can be taken (Smith, 1972). Diseases can dramatically reduce yields and quality of soybeans, can increase production costs and have negative effects on marketing and cropping decisions (Singh, 1998).

DRY ROOT ROT - *Macrophomina phaseolina*

Symptoms

The disease symptom starts initially with yellowing and drooping of the leaves. The leaves later fall off and the plant dies within week. Dark brown lesions are seen on the stem at ground level and bark shows shredding symptom. The affected plants can be easily pulled out leaving dried, rotten root portions in the ground. The rotten tissues of stem and root contain a large number of black minute sclerotia (Fig. 1).

Pathogen

The fungus produces dark brown, septate mycelium with constrictions at hyphal branches. Minute, dark, round sclerotia in abundance. The fungus also produces dark

brown, globose ostiolated pycnidia on the host tissues. The pycnidiospores are thin walled, hyaline, single celled and elliptical.

Favourable conditions

Day temperature of 30°C and prolonged dry season followed by irrigation.

Disease cycle

The fungus survives in the infected debris and also as facultative parasite in soil. The primary spread is through seed-borne and soil-borne sclerotia. The secondary spread is through seed-borne and soil-borne sclerotia. The secondary spreads is through pycnidiospores which are air-borne.

Management

1. Treat the seeds with Carbendazim or Thiram at 2 g/kg or pellet the seeds with *Trichoderma viride* at 4 g/kg or *Pseudonomas fluorescens* @ 10g/kg of seed.
2. Apply farm yard manure or green leaf manure *(Gliricidia maculata)* at 10 t/ha or neem cake at 150 kg/ha.
3. Use resistant varieties like NRC-2, NRC-37, JS 71-05 and JS 97-52

WILT - *Fusarium* oxysporum f. sp*. tracheiphilum*

Symptoms

Symptoms do not appear until the plants are about six weeks old. Initially a few plants are noticed with pale green flaccid leaves which soon turn yellow. Growth is stunted, chlorosis, drooping, premature shedding or withering of leaves with veinal necrosis often occurs and finally plant dies within 5 days. Brownish, purple discoloration of the cortical area is seen, often extends throughout the plant (Rangaswami, 1998, **Fig. 2).**

Pathogen

The fungus produces falcate shaped macroconidia which are 4-5 septate, thin walled and hyaline. The microconidia are single celled hyaline and oblong or oval. The chlamydospores are also produced in abundance.

Favourable conditions

Temperature of 20-25°C and moist humid weather.

Disease cycle

The fungus survives in the infected stubbles in the field. The primary spread is through soilborne chlamydospores and infected seeds. The secondary spread is through conidia by irrigation water.

Management

1. Treat the seeds with Carbendazim or Thiram at 2 g/kg or treat the seeds with *Trichoderma viride* at 4 g/kg.
2. Spot drenching with Carbendazim at 0.5 g/litre.

LEAF SPOT - *Cercospora sojana*

Symptoms

Light to dark gray or brown areas varying from specks to large blotches appear on seeds. The disease primarily affects foliage but stems, pods and seeds may also be infected. Leaf lesions are circular or angular, at first brown then light brown to ash grey

with dark margins. The leaf spot may coalesce to form larger spots. When lesions are numerous the leaves wither and drop prematurely. Lesions on pods are circular to elongate, light sunken and reddish brown (Fig. 3).

Favourable conditions

Fungus survives in infected seeds and warm, humid weather favor disease incidence

Management

1. Use resistant varieties like JS 71-05, JS-335, MACS-13 and NRC-7
2. Use healthy or certified seeds and rotate soybean with cereals.
3. Completely remove plant residue by clean ploughing the field soon after harvest.
4. Seed treatment with Thiram + Carbendazium (1:1) @ 2g/kg seed.
5. Spray Mancozeb @ 2g/L or Carbenzadium (500 mg/L).

SOYBEAN MOSAIC VIRUS (SMV)

Symptoms

Diseased plants are usually stunted with distorted (puckered, crinkled, ruffled, narrow) leaves. Pods become fewer and smaller seeds. Infected seeds get mottled and deformed. Infected seeds fail to germinate or they produce diseased seedlings (Rangaswami, 1998, Fig. 4).

Pathogen

It is caused by *Soybean mosaic virus* - a potyvirus. Flexuous particles 750 - 900nm long.

Disease cycle

Soybean mosaic virus is seed borne. The SMV can be transmitted through sap, 32 aphid species are involved in transmission.

Favorable conditions

Temperature around 18^{o} C and humid weather

Management

1. Deep summer ploughing.
2. Use resistant or tolerant varieties like PK 416, PK472, PK1029, Pusa 37 and JS 9752
3. Use healthy/certified seeds.
4. Keep the field free from weeds and rogue out infected plants and burn them
5. Pre-sowing soil application of Phorate @ 10 kg/ha.
6. Two foliar sprays of Thiamethoxam 25 WG @ 100 g/ha or Methyl demeton 800 ml/ha at 30 and 45 days after sowing (Singh *et al.,* 1992).

Fig. 1. Dry root rot

Fig. 2. Wilt

Fig. 3. Leaf spot

Fig. 4. Mosaic virus

CONCLUSION

Soybean being most important leguminous oilseed crop is greatly affected due to diseases caused by major pathogens like fungi, bacteria, viruses etc. The symptoms can be observed on all plant parts from roots to pods. Reduction in the yield losses up to a great extent can be achieved with the use of resistant varieties and seed treatment.

REFERENCES

Rangaswami, G. 1998. *Diseases of crop plants in India*,3rd Edn. Prentice-hall of India, New Delhi.

Singh, R.S. 1998. *Plant diseases*, 7th Edn. Oxford & IBH Pub. Co. Pvt. Ltd. New Delhi

Singh, U.S., Mukhopadhyay, A.N., Kumar, J. and Chaube, H.S. 1992. *Plant diseases of International importance*, Vol 1-4, Prentice Hall, Eaglewood cliffs, New Jersey.

Smith, K.M. 1972. *A text book of plant virus diseases*. Academic Press, New York.

Feeding of goat milk in orphan piglets

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With proper care, piglets can survive on a diet of goat's milk instead of their mother's milk. Goat's milk is nutritious for a variety of different babies including goats, humans and pigs. Whatever your reason is for feeding baby pigs goat milk, it is imperative that the piglets started with colostrum from their mother. Without this first milk, the piglets will miss out on natural antibiotics and important digestive enzymes so they are able to digest their food and build up a strong immune system.

How to Feed Goat Milk to Baby Pigs

The younger the piglets are when they are no longer cared for by their mother, the less chance they have for survival. It is a sad occurrence that sometimes happens for one reason oranother that a piglet or baby pig becomes an orphan. It is afairly challenging and time consuming job, which also requiresgood luck, to actually save a very young piglet from dying whenit is separated from its mother. The odds are fifty-fifty at best.One of the most important things to remember about being asurrogate mother to a very young piglet is that they need to bekept very warm - around ninety degrees. Using a heating pad or asafe heat lamp hooked where it won't fall down on the piglet isgood. Keep the piglet in a pet carrier or a play pen. If you areusing a play pen drape sheets all around it to keep drafts fromgetting to the piglet. For newborn piglet you can even use ahuman newborn carrier and you can then carry it wherever you go.A newborn piglet does not produce its own heat well until it isat least two weeks old and you must keep it warm in whatever wayyou choose until it is that old. If you do not know how old it isthen give it options so that it can move from warmer to cooler asit chooses. Pigs are very able to let you know when something isuncomfortable.To feed a newborn piglet, use an eye dropper. Be very careful andfeed the milk slowly so that the milk doesn't get into the lungsrather than the stomach.

When thepiglet is very young it can't drink from a bottle and it can't drink from a pan. Some people will twist the corner of a towel and dip it into milk and let the piglet suck on it. Both ways have their problems. Youcan't guarantee that fibers won't be sucked down or that the babypig won't choke on the towel if it becomes untwisted. On theother hand, the dropper can drown a very small pig, so great caremust be taken in either case. For a very young pig, using atwisted corner of a towel or an eye dropper is okay. They are tooyoung to fight you and the need to eat will usually override anystruggles.An older pig can be introduced to the bottle or a small flat dishthe size of an ash tray. To introduce milk in a small dish youhold the piglet in your lap under one arm and use your other handto introduce the dish. A bottle is easier to introduce in somecases than a dish, but piglets will fight both methods because they know it is not mom. Dip the piglet's nose into the milk andafter a few times of doing this and getting milk splashed on youit will eventually get the idea.

Just remember to keep trying and eventually they will get it. It will get easier each time.You can also find commercial sowmilk replacer but it isn't as good for the piglet as goat milkwould be. Warm the piglet's milk to skin temperature just likefor a human baby. A baby pig cannot take in a lot of milk at atime so they will need to be fed every two hours or so.

At a weekold they can go to every three to four hours before being fed. Be sure to keep all utensils sanitary and clean and if you areusing a milk replacer make it the same consistency every time toensure that the piglet is getting enough nutrition. Once youstart a formula do not change this as it can cause digestionproblems. They should be able to sleep throughout the nightwithout eating and wake hungry. Successful hand rearing of orphan pigs is often difficult and time consuming. Piglets will have the best chance at survival if they are able to nurse on the sow within 24 hours of birth to receive the colostrum that allows the piglets to fight off a multitude of early infections by providing immunity to many common viruses and bacteria.

INSTRUCTIONS

1. Keep goat’s milk in the fridge until you need it.
2. Warm the goat’s milk the same way you would for a human baby, either in the microwave or in a pot on the stove.

3. Test the heat of the goat's milk on the inside of your wrist. You want the milk to feel about the same temperature as your skin so you do not burn the babies.
4. Pour goat's milk into a flat pan. The amount will vary according to the age of the piglet; pigs that are one day to one week old will need two to three tablespoons of milk.
5. Hold the pan in one hand and a piglet in the other.
6. Dip the piglet's nose gently into the milk. The piglet will fight at first but it needs to taste the milk in order to learn how to eat on its own.
7. Provide milk every three to four hours, both night and day, until the piglets are about one week old. At this time you can stop the night-time feedings.
8. Clean all the dishes and utensils used to prepare the milk and feed the piglets.
9. Soak pig pellets in the milk prior to feeding when the pigs are three weeks old. Add pellets to the diet slowly to avoid causing digestive problems.
10. Wean piglets between six and eight weeks of age.

CONCLUSIONS

Without the colostrum ingestion most baby piglets die. If the piglet was able to receive colostrum then hand rearing can be successful. Goat's milk is nutritious for a variety of different babies including goats, humans and pigs. Whatever your reason is for feeding baby pigs goat milk, it is imperative that the piglets started with colostrum from their mother. Without this first milk, the piglets will miss out on natural antibiotics and important digestive enzymes so they are able to digest their food and build up a strong immune system. The younger the piglets are when they are no longer cared for by their mother, the less chance they have for survival.

Monitoring of Aphids Infesting Potato and other Crops

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Aphids are major pests of many agricultural and horticultural crops. Over 4700 species of aphids are reported worldwide and about 100 species are of economic importance. Notable crops infested are potato, wheat, barley, sweet potato, cotton, brassicas and numerous other vegetables. Management of aphid vectors is of particular importance for healthy seed potato production. Mor than 65 species of aphids are known as vectors of various potato viruses e.g. Potato Virus Y (PVY) and Potato Leaf Roll Virus (PLRV). Fourteen species of aphids are reported to infest potato in India (CPRI, 2017). Monitoring and forecasting of aphids are aimed at optimizing the nature and timing of control measures. The degree to which monitoring and forecasting influence the grower community depends ultimately on the proven robustness of the methods and the cost of control. More recently, there has been interest in longer-term forecasting in order to assess the likely impacts of global environmental change. Monitoring aphid abundance can lead directly to control decisions provided that economic threshold levels in the crop and their relationship with the monitoring data are known. However, in many cases, especially in seed crops where aphids are important as virus vectors, any aphid activity may be unacceptable during the susceptible stages of crop growth. Thus, as soon as aphids appear, control is necessary and hence monitoring simply for presence can provide an immediate return. Forecasting the time of the start of aerial activity can provide necessary input to initiate monitoring in the crop. As well as distribution, abundance, and phenology of aphids, it may be useful to monitor or predict certain aphid attributes such as whether they are carrying viruses or are resistant to certain insecticides.

Monitoring and forecasting may be carried out at various spatial scales depending on objectives and available resources. Crop monitoring provides data that are of more local value than aerial monitoring but, because of the generally aggregated distribution patterns of aphids in crops, multiple samples are needed in single fields to assess the variance. When aerial monitoring, the higher above ground the sample is

taken, the less will be the aggregation. As a result, the area represented will be greater, especially where there is little topographical variation, but samples will not take account of local variation in crops. Growth stage of the crop also determines the intensity of monitoring for example, as potato crops mature, the chance of newly acquired virus reaching the tubers is reduced and vectors become less important. In general greater the frequency of sampling, the better. Inevitably, costs dictate limitations.

Table 1 lists a range of methods commonly used for sampling aphids, together with some of the major considerations when assessing their suitability for the intended purpose of the sampling programme (Figure 1). Heathcote (1972) gives more detail on sampling, extraction, and counting techniques for evaluating populations on plants, and Taylor and Palmer (1972) provide the same for aerial sampling. Harrington *et al*. (2007) have summarised the principles of aphid monitoring and forecasting the principles of monitoring aphids in potato seed crop in India have been described by Singh *et al*. (2015). The most significant recent advance is the ability to monitor the genetic structure of populations, and to screen individuals in this respect with ever-increasing precision. Advances have also been made as a result of the phenomenal increase in computing power, enabling improved database management, data analysis, developing forecasting models, and information dissemination.

Monitoring in crops

Direct assessment of aphid densities in crops is a must for researchers attempting to determine economic control thresholds and by agronomists and growers wishing to apply them. In potato, a threshold of 2 individuals of *Myzus persicae* per 100 compound leaves is used as management threshold while as a threshold of 20 aphids per 100 compound leaves is used for haulm cutting in India (Singh *et al*. (2015).

Aerial monitoring

Several trap networks have been permanently or occasionally operated in order to monitor and forecast aphid flight dynamics particularly with reference to potato and wheat crops. The most extensive involves aerial monitoring using 12.2 m suction traps in Europe. There are also long-running networks of 8 m suction traps in some states of the USA and a few traps in other locations such as New Zealand. Most traps are emptied daily during the aphid season. The area represented by a trap varies according to topography, variously reported as 80, 400 and 700 Km. Recent progress in data handling and dissemination through the web has enlarged use of the information by the farming community. For instance, weekly bulletins from the Scottish Agricultural Science Agency provide information on the abundance of known vectors of PVY and PLRV, as well as appropriate commentaries and comparisons with previous years

Table 1: Attributes of common aphid sampling methodologies (Modified after Harrington et al., 2007)

Sl. No	Advantages	Disadvantages
A. Crop sampling		
1.	***In situ* counts on plants**: Measure absolute abundance per plant or plant part	

	• Part of plant colonized can be recorded • Can monitor progress on individual plants • Suitable in a sequential sampling programme • Provides immediate results	• Time-consuming in the field • Difficult and sometimes uncomfortable • Results are weather dependent • Results depend on observer efficiency • Cannot adequately record non-colonizers • Problem with inaccessible aphids (between leaves, on roots)
2.	**Destructive counts on plants:** Measure absolute abundance per plant part	
	• Part of plant colonized can be recorded if bagged separately • Quick in the field • Exhaustive	• Time-consuming in the laboratory, although counting and identification can be postponed to a convenient time provided that plants are stored at 3°C or lower to prevent further aphid development
3.	**Vacuuming from plants:** Measures absolute abundance per unit area	
	• Quick in the field	• Time-consuming in the laboratory, although counting and Identification can be postponed to a convenient time Tends to bias towards older/larger and winged aphids • Results are weather dependent • Reliable quantification is difficult
B. Aerial sampling		
a) Impaction traps. Sample size depends on wind speed and shape of trap surface. Colour of the surface will affect the sample size in a species-specific manner.		
4.	**Coloured water traps:** Measure relative abundance and can be used to compare catches of a given species over space or time, assuming similar behaviour of different clones, but not to compare across species	
	• Many individuals caught if yellow coloured trap is used	• Species bias depending on colour preferences • Aphids cannot be collected alive • Reflections may affect alighting behaviour • May dry out in hot weather unless emptied regularly • Overflowing in wet weather can be prevented by using mesh drains on the sides)
5.	**Clear/plant-coloured water traps:** Measure absolute numbers alighting per unit area	

	• Sample is representative of individuals landing in crop i.e. actual landing rate • Non-colonizing species can be recorded	• Very few individuals caught compared to yellow traps • Reflections may affect alighting behaviour • Aphids cannot be collected alive
6.	**Sticky traps:** Measure relative abundance	
	• Can be vertical, horizontal, laminar, or cylindrical	• Dealing with samples is difficult • Samples may be in poor condition • Aphids cannot be collected alive
b) Filter traps. These traps collect air and filter aphids from it.		
7.	**Nets (pivoted or non-pivoted):** Measure relative abundance of different species flying at a given height	
	• Aphids can easily be trapped alive and transferred immediately to plants to test for virus infectivity	• The volume of air sampled depends on wind run, but can be controlled if vehicle mounted • Need constant attendance
8.	**Suction traps:** Measure absolute abundance per unit volume of air	
	• Constant, known volumes of air can be sampled • Efficiency is almost independent of wind speed • Aphids can be collected alive or dead • Samples can be automatically divided according to time	• Require electricity • Sampling is usually at a single height • Low level traps sample aphids that are not randomly distributed (Aphids are randomly distributed above about 10 m) • Fixed in position.

(www. sasa.gov.uk/seed_potatoes/aphids/bulletins/index.cfm)

Agronomists in Scotland use this information to provide advice to potato growers. Yellow water-pan traps are regularly used to monitor local movement of aphids. Also, the collected aphids can be used to test for the presence of viruses and insecticidal resistance status.

Monitoring aphid attributes

MORPH. Differentiation of aphid morphs gets importance if there is difference in characteristic of concern. For example, in order to assess the risk of Barley Yellow Dwarf Virus (BYDV) by *Rhopalosiphum padi* (bird cherry–oat aphid), whilst all three winged forms are capable of introducing the virus to an autumn-sown cereal crop, only the virginoparae will colonize the crop and produce offspring that may spread the virus. Similarly, aerial sampling deals only with winged aphids, whereas crop sampling can be used to gather information on both winged and wingless aphid morphs.

INSECTICIDE RESISTANCE. Routine monitoring of the insecticide resistance status of aphids can provide valuable information for control programmes involving insecticides. The esterases responsible for conferring the most prevalent resistance mechanism in

Myzus persicae can be detected by immunoassay using aphids trapped alive or trapped and stored for up to 2 weeks in a purpose designed, glycerol-based solution. Aphids from this solution can also be tested for target-site resistance using various methods. Point mutations in the sodium channel that confer knockdown resistance to synthetic pyrethroids can be detected from live or alcohol preserved specimens by using real-time fluorescence PCR.

VIRUSES IN APHIDS. Persistent viruses can readily be detected routinely in individual aphids using double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) e.g., *Potato leaf roll virus* (PLRV) in *Myzus persicae* and *Macrosiphum euphorbiae*. Detection of persistent viruses can be improved by the use of molecular techniques such as standard- or real-time reverse transcription-polymerase chain reaction (RT-PCR). Non-persistent viruses, because of the very small titre of virus in the aphids, present more of a challenge than persistent viruses when it comes to detection in individual aphids. However, duplex RT-PCR and other advancements of the technique have been standardised for many aphid-virus combinations e.g., Potato virus Y (PVY) in *Myzus persicae*, *Macrosiphum Euphorbiae* etc. provided the aphid specimens are collected and preserved in propylene glycol.

To conclude, the monitoring of aphids forms an important part of integrated pest management regimes of various crops. Monitoring programs also provide necessary input for short and long term forecasting insecticidal resistance status and virulence of various economically important aphid species.

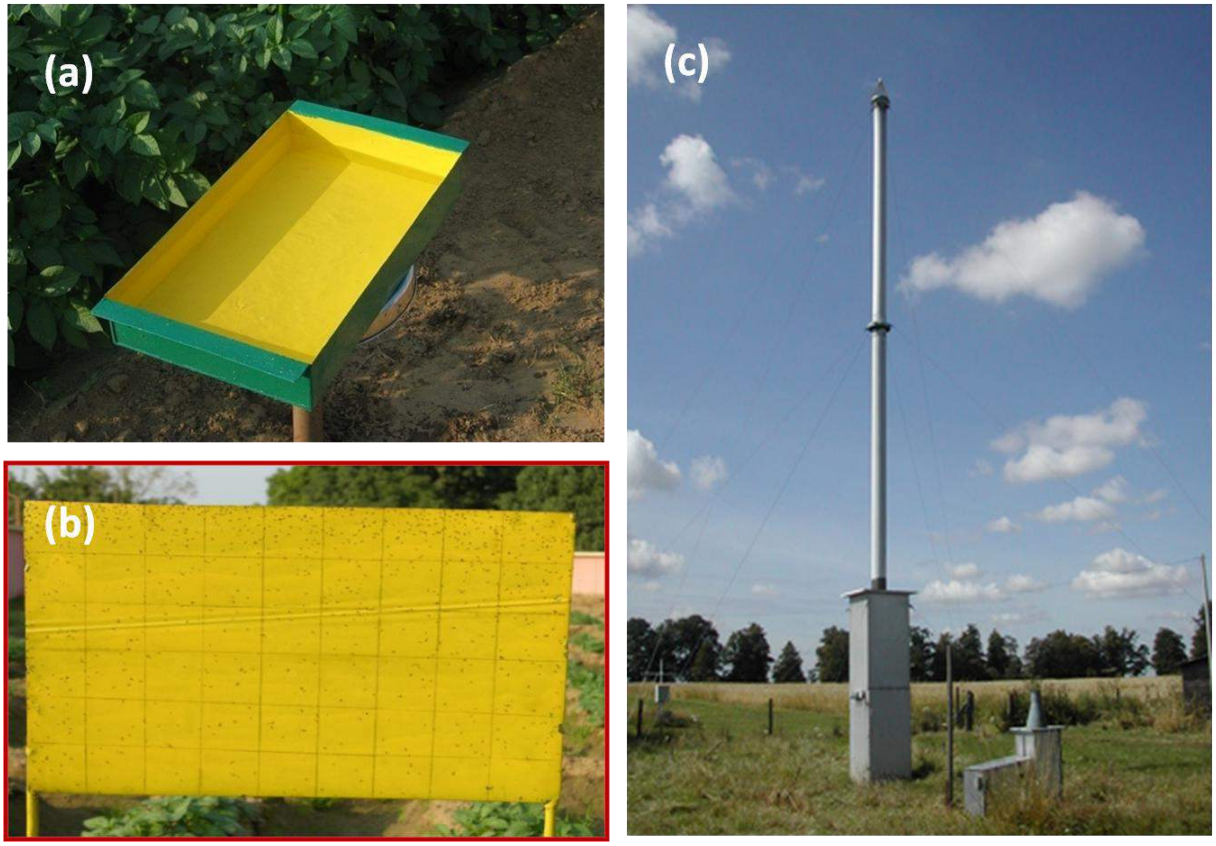

Fig. 1.1: Common aphid sampling methods: (a) yellow water pan trap; (b) yellow sticky trap; (c) suction trap (courtesy of Rothamsted Research).

REFERENCES

Central Potato Research Institute. 2017. Annual Report 2016-17. ICAR-Central Potato Research Institute Shimla, Himachal Pradesh, India. 218 pp.

Harrington R., Hullé, M. and Plantegenest, M. 2007. Monitoring and Forecasting. In: van Emden, H.F. and Harrington (Eds.) *Aphids as Crop Pests*. CAB International, Oxfordshire, pp. 515-536.

Heathcote, G.D. 1972. Evaluating aphid populations on plants. In: van Emden, H.F. (Ed.) *Aphid Technology.* Academic Press, London, pp. 105–145.

Singh, B.P., Nagesh, M., Sharma, S., Sagar, V., Jeevalatha, A., Shridhar, J. 2015. A Manual on Diseases and Pests of Potato. ICAR-Central Potato Research Institute, Shimla, Himachal Pradesh, India. 90 pp.

Taylor, L.R. and Palmer, J.M.P. (1972) *Aerial sampling*. In: van Emden, H.F. (Ed.) *Aphid Technology.* Academic Press, London, pp. 189–234.

Feeding management of high yielding dairy cows

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Managing high yielding dairy cows is all time being a challenging task for the dairy farmers. A number of changes occur in cows as they progress through different stages of lactation. Besides variations in milk production, there are changes in feed intake and body condition, and stage of pregnancy. Knowledge about feeding management will always be helpful to meet out the nutrient requirement of dairy cows. Poor feeding management of cows can lead to shorter, lower yielding lactations and increase calving interval. There are three main stages in the lactation cycle of the dairy cow: (a) early lactation (14-100 days) (b) Mid lactation (100 to 200 days) and (c) Late lactation (201-305 days). The interrelationships between feed intake, milk yield and live weight in high yielding cows is presented in Figure 1.

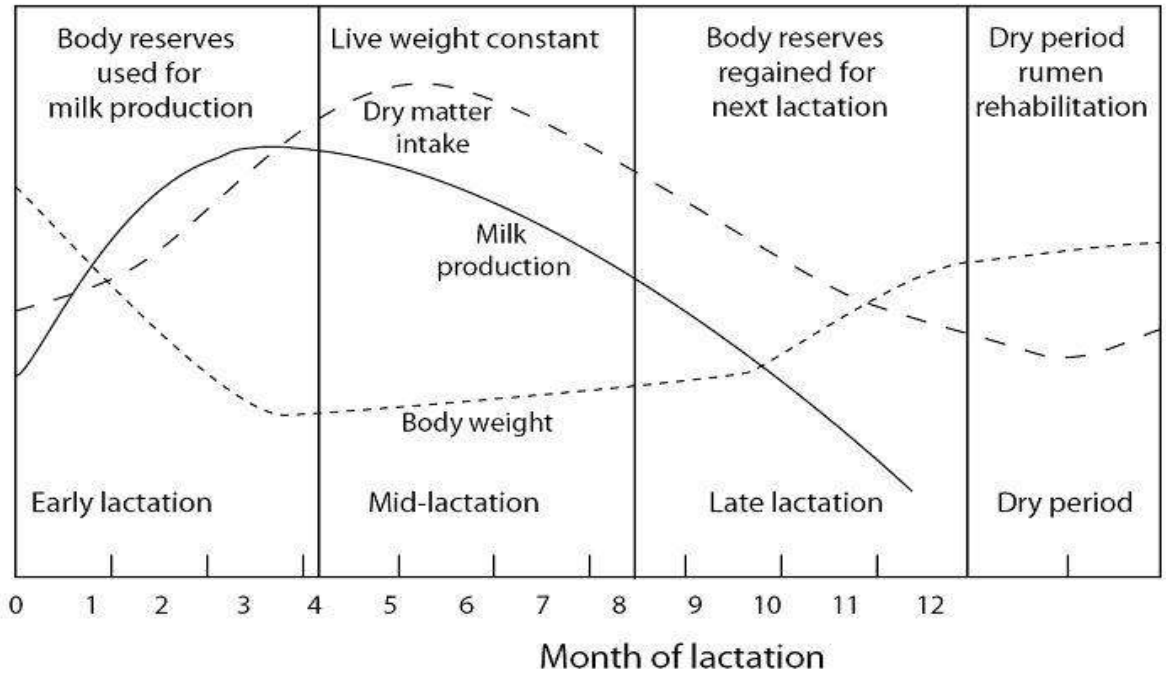

Figure 1. Dry matter intake, milk yield and live weight changes in a cow during her lactation cycle

The modern dairy cow faces “stress” from many sources including the environment, disease and particularly the “metabolic load" created by high yields. A dairy cow, giving 30 Kg of milk per day is performing at well over three times her maintenance requirements for energy; it is nearly five times maintenance requirements for a high yielding animal giving 50 Kg per day.

Metabolic load

At the onset of lactation there is a massive and rapid increase in nutritional requirements, which the dairy cow is unable to meet because of the limitation in voluntary dry matter intake. The question is when does the metabolic load involved in fat mobilization lead to a stressful situation and reduced welfare? Certain level of metabolic load the animal is not challenged; even at high intensity of metabolic load the animal remains largely unchallenged provided that the duration is short and vice versa. When the metabolic load reaches a level where it becomes challenging, the animal will attempt to cope by beha vioural and physiological response. Further increases in metabolic load will leave the animal unable to cope and will lead to pathological response. In the context of energy deficiency in early lactation we could define pathological response when the concentration of ketone bodies in blood is raised above a certain level e.g. levels of ß-hydroxybutyrate above 1 mmol/l, which is recognised as the upper limit of normal physiological level in early lactation (Whitaker *et al.* 1983).

THE METABOLIC CYCLE OF THE LACTATION

The productive year of the cow can be divided into three phases largely dependent on the hormonal changes that occur (Holtenius, 1994). First we have a phase of catabolic reactions where body tissues are broken down. This is an obligatory hormonally controlled fat-mobilization which is to a certain extent independent of energy balance. The catabolic phase starts 2-3 weeks before calving and extends 6-12 weeks into lactation depending on how well the cow is managed and fed. After the catabolic phase, which is the most complicated period and where most of the metabolic disturbances occur, we have a 5 months period of equilibrium. After the equilibrium phase the anabolic reactions become dominant and this phase extends into the dry period.

The selection of cows for high milk production is a selection for cows with great metabolic capacity i.e. these cows can produce precursors for milk synthesis by utilizing the feed and the body reserves in an efficient manner. To a large extent the metabolic capacity means the ability of the cow to produce glucose, glucose being the main determinant of the amount of milk the cow is producing in early lactation.

VOLUNTARY FEED INTAKE

Energy intake is the first limiting factor in sustaining high yield in dairy cattle. In northern Europe and in particular Iceland, where the ration consists to a large extent on grass silage, it is vitally important that it is of high quality in order to ensure high dry matter intake. Within organic farming at least 60% of the dry matter in daily rations should consist of roughage, fresh or dried fodder, or silage. Permission can be granted for reduction to 50% for animals in dairy production for a maximum period of three

months in early lactation.. It is important to realize the physical limitations of voluntary dry matter intake, in particular in the organic system where the ration contains large amounts of roughage. Voluntary dry matter intake is affected by animal, management and nutritional-factors. As the digestibility of feed increases so does the dry matter intake. Maximum energy intake is achieved when large proportion of the ration (75%) consists of concentrates (Broster *et al.,* 1979). Supplementation with concentrates may improve intake of very poor roughage but generally it reduces roughage intake. The rate of substitution increases with increasing quality of the roughage (Broster *et al.,* 1979). Concentrates are necessary in dairy rations for at least two reasons. Firstly, concentrates are necessary to ensure high dry matter intake and secondly, to correct the nutritional imbalance inherent in grass silage. Large proportion of the protein in grass silage is in the form of quickly degraded protein while the carbohydrate portion is slowly fermentable. This causes imbalance in the fermentation pattern, which can only be corrected by the supply of more easily fermentable carbohydrate.

FEEDING MANAGEMENT OF DAIRY COWS IN DIFFERENT STAGES OF LACTATION

1. Early lactation

The first 100 days of lactation are usually regarded as early lactation period. At the beginning of this phase, cows achieving peak milk production, lags in feed intake and cows are usually lose weight. Rations for lactating dairy cows are usually formulated based on protein (e.g. CP) and energy (e.g. net energy for lactation) requirements. However, to achieve maximum production, dairy rations should be balanced for effective fibre, non-structural carbohydrates, ruminal undegraded protein, soluble protein. Dairy rations are usually formulated to maximize microbial yield and for requirements for ruminal un-degraded amino acids.

Energy status in early lactation

Bovine ketosis is a major problem on Icelandic dairy farms with incidence of about 18 treatments/ 100 cows /year (Hardarson, 1999) compared with 2-5 treatments/ 100 cows in most European countries. The reason for this high incidence in Iceland can to a large extent be explained by the low energy concentration of the rations normally fed to dairy cows in Iceland, as shown by a significant correlation between ß-hydroxy-butyrate and energy status (Hardarson, 1980). When it comes to comparing the incidence of clinical ketosis in organic herds and conventional herds most studies in

Europe report similar (Krutzinna *et al.*, 1996) or even lower (Weller and Cooper, 1996) incidence of clinical ketosis in the organic herds, although herd variation is great (Vaarst, 1995). Concentration of ketone bodies in blood has been studied with contradictory results. (Von Weber et al., 1993) in Germany reported high incidence of hyper ketonaemia without clinical cases in organic herds and (Olesen and Thuen, 1996) in Norway reported low ketone levels in organic herds.

These different results are not surprising because as far as milk production and ketosis is concerned there are three options for the high potential dairy cows depending on how the cow is fed and managed. Firstly, we have well managed cows in good condition fed well balanced ration according to genetic potential reaching high yields and maintaining good health, with normal ketone levels.

This is what the progressive dairy farmer in the conventional system has been pursuing. Secondly, we have cows fed and prepared in the right manner during late lactation and the dry period but in early lactation the ration does not meet the requirements of the high yielding cow and consequently ketone levels are high with or without clinical ketosis and intermediate yields. And thirdly, we have cows fed low digestible roughage and maintained in thin bodily condition throughout the year. By maintaining the cows in poor bodily condition at calving i.e. body score ≤2, milk yield will be reduced. The level of production may also be affected by the protein: energy ratio in the feed. If the protein: energy ratio is low milk yield will be reduced. The genetic potential of these cows is not expressed, which results in low yields and apparently good health.

Body Weight Loss during Early Lactation

During early lactation, milk yield increased more rapidly than dry matter intake therefore demand for energy is higher than the amount of energy consumed. Thus the cow mobilizes body reserves and losses weight (negative energy balance). The genetic potential is usually expressed during this period the cows with higher genetic potential were mobilized body fats for a longer period of time than cows with a lower genetic potential the cow could lose as much as 0.7 kg/day. However, the cow at this stage has a limited capacity to ingest the required amount of feed. Feed intake is the key factor in maintaining high milk production. Cows should be encouraged to maximize their intake during early lactation. Each additional kg of dry mater consumed can support 2-2.4 kg more milk. Feed intake by the dairy cow is influenced by many factors including level of production, forage quantity and quality, feed digestibility, feed processing, feeding frequency, consistency of ration ingredients etc.

Feeding Strategies:

i. Cows usually eat after milking. Thus fresh feed should immediately be always available in the feed bunks/mangers to encourage feed consumption. High producing cows eat up to 12 meals per day, each average 23 minutes. Wetter or drier rations definitely limit intake hence, total mixed ration (TMR) possessing dry matter between 50-75% should be provided.

ii. Dry matter intake (kg) for lactating dairy cows

Time (Weeks) after calving	DMI % of actual BW
1	2.5
2	2.9
3	3.4
4	3.6
5	4

Calculation of dry matter intake

The following equation can be used to calculate dry matter intake DMI (% body weight) = 4.048 – 0.00387 x body weight (kg) + 0.0584 x 4% FCM (kg) Use the following equation to calculate 4% FCM = 0.4 x actual milk yield in kg/day) + 15 x milk fat in kg/day. Maintaining good rumination is essential in early lactation. Thus it is important to feed at least 40% of the ration dry matter as forage. About half of the forage should have a particle length of at least 2.6 cm to effectively stimulate chewing. Neutral detergent fibre and acid detergent fibre levels should be set at 28 and 19%, respectively to maximize intake. Major ration changes should be avoided. To avoid any digestive problems concentrates should be added gradually at a rate of about 0.5 to 0.7 kg/day for the first two weeks. Protein is very critical during early lactation as the amount of body protein that can be mobilized is very limited compared with body fat. Thus in early lactation, a dietary protein content of 17-19% is recommended. About 35-30% of dietary protein should be ruminally undegraded protein while 30% should be soluble protein. A guideline is to feed 0.5 kg of a 34 to 50% protein concentrates for every 5 kg of milk produced above 20 kg of milk.

iii. If concentrates are being fed separately from forages, they should be fed several times a day

iv. Feeds should be available to cows at least 20 hours per day

v. Hay should be fed before grain and / or protein supplement in the morning

vi. Protein supplements should be fed with energy sources and / or feed the energy source before protein

vii. Forage should be checked to make sure it contains enough long fibre

viii. If two forages are being fed, it is preferable to mix them rather than feed them separately

ix. If intakes are below normal begin by checking the non-fibre carbohydrate level, forage particle size and water quality

FEEDING CONCENTRATE SEPARATELY:

Many dairy farmers usually practice feeding of concentrate only once or twice daily. This result in non-uniform supply of nutrients and inefficiencies in nutrient utilization can occur. Providing smaller and more frequent meals of concentrates stabilize the rumen environment. Several management strategies can be used to improve milk production and cow health in component-fed herds.

1. Avoid large variation in forage quality
2. Feed forages frequently and push up feed frequently. This practice helps keep feed fresh and encourage cows to eat smaller meals more often.
3. Feed some in the morning before cows have access to concentrates.
4. Do not feed more than 2.5-3.5 kg of grain per feeding. Limiting the amount of grain fed at one time lowers the risk of creating acidotic conditions in the rumen due to rapid breakdown of carbohydrates in the rumen.
5. Watch Particle size of grain. Finely ground grains breakdown rapidly in the rumen and can lead to acidosis problem.

Feeding frequency:

Increased feeding frequency reduces daily variations in rumen pH and thus helps stabilizing the rumen environment. Frequent delivery of feed improves access to feed for all cows, particularly during peak feeding periods when fresh feed is provided, and reduces the amount of feed sorting (DeVries *et* al., 2005). The proper range and consistency of ruminal pH is critical in fibre digestion.

Feeding sequence:

There is definite feeding sequence in high yielder as rumen microbes require both energy and protein to grow and ferment feed in correct rate of degradation of carbohydrate consequently maintained the volatile fatty acid in proportionate results in higher milk fat percentage. So that's why forages should be fed first in the morning followed by a portion of the grain mix.

Mixing accuracy:

A TMR or forage combination must be adequately mixed in order to provide a proper nutrient balance. When mixing small quantities of specific ingredients (e.g. minerals and vitamins), it may more appropriate to include them in a pre-mix where larger quantities can be added to the ration.

2. Mid-lactation:

Mid-lactation period is the period between 100 to 200 days after calving. By the beginning of this phase, cows which achieved peak production (8-10 weeks after calving) dry matter intake will also reaches to its peak with no more weight losses. Cows should reach maximum dry matter intake no later than 10 weeks after calving. At this point, cows should be eating at least 4% of their body weight. For every 2 kg of expected milk production, large-breed cows should eat at least one kg of dry matter. The main target during this period is to maintain peak milk productions as long as possible. For each extra kg of milk at peak production, the average cow will produce 200- 225 kg more milk for the entire lactation. Thus the key strategy during mid-lactation is to maximize dry matter intake. During this period the cow should be fed high quality forage (minimum 40 to 45% of the ration dry matter) and the level of effective fibre should be maintained at a level similar to that of early lactation. Concentrates should not exceed 2.3% of body weight and sources of non-forage fibres

such as beet pulp, distiller's grains and cereal bran can replace part of the starch in the ration to maintain a healthy rumen environment. Protein requirements during mid-lactation are lower than in early lactation. Therefore rations for dairy cows in mid-lactation should contain 15-17% crude protein. During this period the cow should be bred to initiate a new pregnancy (60-70 days after calving).

3. Late-lactation

This phase may begin 200 days after calving and end when the cow dries off. During this period, milk yield continues to decline and so does feed intake. However, the intake easily matches milk yield. The cow also gains weight during this period to replenish the adipose tissue lost during early lactation. However, as lactation approaches an end, more of the increase in body weight is due to the increased size of the growing foetus. Sources of protein and energy are not very critical during this period. Cheap rations can be formulated with non-protein nitrogen and a source of readily fermentable carbohydrates such as molasses. Nutrient requirements for dairy cows in late lactation are shown in Table 1.

Table 1. Guidelines for feeding high yielding dairy cows in different stages of lactation.

Stage of Lactation	Early	Mid	Late
Ave. milk yield (kg/d)	40	30	20
DMI (kg/d)	24-26	21-23	11-12
CP (% DM)	17-19	15-16	13-15
Fat (maximum in DM)	5-6	4-6	3-5
Vit. A (1000 IU/day)	100-200	100-200	100-200
Vit. D (1000 IU/day)	20-30	20-30	20-30
Vit. E (IU/day)	600-800	400-600	400-600

Buffer feeding high yielding dairy cows

The main constraint cows experience at grass is an effective shortage of energy almost entirely due to relatively low total intakes of forage from grazing. The potential consequences are:

1. Excessive loss of condition in early lactation often undetected until well advanced.
2. Poor fertility not apparent until the damage is done and cows are returning to service. This is particularly a problem for summer calvers.
3. Poor milk protein production also often not apparent until much of the damage is done
4. Shortened lactations.
5. Increased involuntary disposal rate because of failure to conceive to fit the pattern.

Consider the new calved and high yielding before all else if necessary/practical separate them from stale cows. If herd feeding is planned based on cows passed peak, those in early lactation will suffer. This is usually not seen until much harm for future productivity has been done. It can be quite easy for a farmer not to realise that cows at

green grass under a blue sky with sun on their shining coats are actually losing 1-2 kg bodyweight per day undetected.

Buffer Feeding System

High nutritive value and palatable conserved forage is required. Maize silage from the previous autumn is often used most successfully. First cut grass silage or whole crop mixtures can also be used. The timing in the day when the buffer is offered is critical for the whole approach to work - for early lactation cows in particular. They need to be brought into the buildings, a yard or a bare paddock and confined there, with access to the buffer only, for 2-4 hours before afternoon milking. The amount should be adjusted so that it is finished 20-30 minutes before milking. Consumption of grass after evening milking is higher, according to research done at the Institute of Grassland and Environment Research, because leaves accumulate highly digestible sugars during the day and herbage dry matter increases as water is lost from the leaves. Feeding the buffer before milking allows this attribute to be better utilised and enables cows to eat more food in total. If the facilities allow it, some concentrates should be mixed with the forage as well. High yielding newly calved cows will always have difficulty achieving reasonable nutritional balance where concentrates are fed only twice daily at milking time. Buffer feeding at or after milking or in the field results, even in staler cows, in uneven and lower total forage intakes and wastage of the buffer. Substitution by the buffer of grazing may be the main outcome. Strip or paddock grazing is often just right for total utilisation of the grass but just too tight for the cows the newly calved in particular. It is quite common to be able to plot when cows have gone into fresh paddocks just from a rise in the bulk tank returns. That means grazing becomes limiting as each paddock gets used up and it is always the recently calved which suffer the most. Strip grazing is more difficult to monitor but generosity to the cows is best in the long run for total productivity and for revival of the pasture.

Maximise feed intake

The most important aspect of maximising voluntary feed intake is to look after the rumen. Firstly, do not insult the rumen. Secondly, feed the rumen correctly. The major insults the rumen suffers are high intakes of starch and fat, large meals of these nutrients, and acid overload. Starch and fat must therefore be included in the diet with care, to ensure that they do not adversely affect the balance and growth of the rumen microbial population. The best way to do this is to ensure that starch and fat (i.e. the concentrated feed ingredients of the diet) are eaten in several small meals each day, or mixed together intimately with forage in a complete diet. The rumen has to buffer both the acids in silage and the VFA produced by the microbes. Reducing the acid load in silage and feeding alkali feeds (e.g. soda grain) will help to maintain the pH of the rumen at approximately 6.5. The feeding area should be away from draughts and rain, and should preferably be sited adjacent to the living area such that the cows have maximal access to the feed trough throughout the day. The diet should be offered ad libitum, which implies a certain amount of wastage. About 10% of the total amount of feed

offered to high-yielding cows should be refused and removed from the feed trough frequently. This material need not be totally wasted as it can be "diluted" and offered to lower-yielding groups of cows where maximising voluntary intake is not so important.

If there is a stampede of cows when new feed is put in the trough the diet is not being offered ad libitum. No more than half the cows should show an interest in the feed as the feed trough is filled or refilled. Feed troughs should be cleaned out several times a week, but never by the cow. Trough space should be adequate, both in terms of the volume of feed it contains and the length of feed space allocated per cow.

Cows are gregarious animals and voluntary intake will be maximised if the entire group can feed at once. Similarly, intake will be maximised if sufficient feed is within reach and the cow does not have to strain against awkward feed barriers. Feeding areas should be quiet and peaceful; the cow is most vulnerable to attack (from predators and other cows) when she is feeding and so a secure environment will ensure long uninterrupted feeding sessions.

Milk contains about 85% of its weight as water. Reduced water intake can quickly restrict milk production. Cows should have access to water immediately after milking, especially if they receive dry feeds in the parlour. The water trough and piped water supply should be adequate to meet requirements, so that the tank is still full when the last cow to be milked arrives to take a drink. Voluntary intake is maximised if the water is clean and fresh. When troughs are first installed a large drainage bung should be fitted so that washing out is easy and can be performed regularly. Water intake and outflow of digesta from the rumen were raised following the application of sodium fertiliser to the pasture. Herbage intake, degradability of dry matter and rumen pH were elevated, resulting in an increased fat content in milk.

Formulating diets: When formulating diets for high-yielding cows all the ingredients must be included. Some producers go so far as to say that all feeds must be analysed before they are used to ensure that their quality is satisfactory. Certainly any feed that contributes more than 2 kg of the dry matter intake should be analysed for its primary nutrient. Maize silage is a common factor in many diets for high-yielding cows, but it should contain at least 30% starch in the total DM.

Some producers use very complex mixes with several sources of protein and several sources of energy in a bid to minimise the effects of variation between batches of raw materials.it is also important to realize that ketosis is only a part of the so-called periparturient disease complex, which includes milk fever, mastitis, retained placenta,

endometritis and poor fertility, as well as bovine ketosis. All these diseases are interrelated and reflect to a large extent the nutritional status of the animal.

CONCLUSION

A challenging task for the dairy farmers to managed high yield dairy cattle. The farmers should aware about their demand and supply of various critical nutrients during the entire lactation. However energy intake is the first limiting factor in sustaining high yield in dairy cattle. There are three main stages in the lactation cycle of the dairy cow: (a) early lactation, mid lactation and late lactation. Whenever the metabolic load reaches a level where it becomes challenging, the animal will attempt to cope by behavioural and physiological response so as to avoid the metabolic load" created by high yields. Therefore the farmer can be strategize feeding of their high yielder by proper guidelines such as Energy status of animal, feeding concentrate separately, feeding frequency, feeding sequence, mixing accuracy, buffer feeding system, maximising feed intake with the help of feed formulation and animal may remain healthy throughout entire lactation.

REFERENCES

Broster, W. H., Sutton, J. D and Bines, J. A. (1979) Concentrate: Forage ratios for high yielding dairy cows. In: Recent Advances in Animal Nutrition 1978. Studies in the Agricultural and Food Sciences, Butterworth.

DeVries T.J., von Keyserlingk, M.A.G and Beauchemin, K. A. (2005). Frequency of Feed Delivery Affects the Behavior of Lactating Dairy Cows. *Journal of Dairy Science* 88 (10):3553-3562

Hardarson, G. H (1980). An investigation into bovine ketosis in Iceland and its relationship to feeding practices. Thesis submitted to MPhil degree at Edinburgh University.

Hardarson G. H. (1999). Records from own practice.

Holtenius, P. (1994). The metabolic capacity, a factor of importance for health and production in dairy cows. Proc. XVII Nordic Vet. Congress, 185-189.

Krutzinna, C., Boehncke, E and Hermann, H. J. (1996). Organic milk production in Germany. *Biological Agriculture and Horticulture* (13): 351-358.

Olesen, I and Thuen, E. (1996). Ketonlegemer I blod of mjölk of ketosetendens I ökologisk mjölkeproduksjon. Husdyrforsöksmöte, 206-210.

Vaarst, M. (1995) Sundhedstilstand of sygdomshandtering I Danske økolgiske malkekvægbesætninger. Dansk Veterinærtidsskrift (78): 966-970.

Von Weber, S., Pabst, K., Schulte-Conerne, H., Westphal, R and Gravert, H. O. (1993) Five year studies on conversion to organic milk production. 1. Production technology. Zuchtungskunde (65):325-337.

Weller, R. F and Cooper, A. (1996). The health status of dairy herds converting from conventional to organic dairy farming. *Vet. Rec.* (139):141-142.

Whitaker, D. A., Smith, E. J and Kelly, J. M. (1983) Subclinical ketosis and serum beta-hydroxybutyrate levels in dairy cattle. *Brit. Vet. Rec*. (133):61-64.

Diagnostic approaches to brucellosis in animals: An overview

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Bovine brucellosis is a serious disease of livestock that has significant impacts on animal & public health, and international trades. Brucellosis may give rise to significant economic losses to farmer that result from decreased productivity, abortions and weak progeny and is a major barrier for commerce and export. Considering the damage caused by the infection in animals and its serious threat to transmission to humans, a precise diagnosis of infection is important for the control of the disease in animals and consequently in man. Presumptive diagnosis of brucellosis is made by the use of several serological tests to detect antibodies against *Brucella spp*, but the "gold standard" remains isolation and identification of the bacterium. Diagnostic methods include indirect tests, involving detection of antibodies which are applied either *in vitro* (mainly to milk or blood) or *in vivo* (allergic test) while direct tests involve microbiological analysis or DNA detection by polymerase chain reaction (PCR) based methods.

1. Indirect tests

a. Serum Agglutination Test (SAT) - This test is based on the detection of agglutinin antibodies mainly of the IgM isotype. At an optimum concentration of antigen and antibodies, an antigen-antibody complex is formed and precipitate at the bottom of the test tube. This reaction is slow and requires overnight incubation at 37ºC. Although test is simple and cheap to perform, but it lack sensitivity (81.5%) and specificity (98.5%) and should only be used in the absence of alternative techniques. This test is no longer recommended by the OIE for diagnosis of bovine brucellosis.

b. Rose Bengal plate test (RBT) - The RBT is a simple spot agglutination test where drops of stained antigen and serum are mixed on a plate and resulting agglutination signifies a positive reaction. This was originally developed for herd screening in veterinary medicine as it is oversensitive in individual animal but is nowdys often used for the diagnosis of human brucellosis. The OIE considers these tests "prescribed tests for trade."

c. Complement Fixation test- This test is based on the non haemolysis of sheep red blood cells by a complement system when test serum is added with CFT antigen in a positive sample. The sensitivity (91.8%) and specificity (99.9%) of the CFT is good, but it is a complex method to perform requiring good laboratory facilities and trained staff. Because the test is difficult to standardize, it is progressively being replaced by ELISAs. This test is a "prescribed test for trade" by the OIE.

d. 2-Mercaptoethanol test -The 2-mercaptoethanol is a confirmatory test that allows selective quantification of IgG anti-Brucella due to inactivation of IgM in chronically infected patients. Sensitivity of the 2-mercaptoethanol test varies from 88.4 and 99.6%, and its specificity ranges from 91.5 to 99.8%.

e. Coombs test-Coombs test is used for detection of incomplete, blocking or non agglutinating IgG in SAT test in relapsing patients with persistent disease. But it misses 7 % cases that are detected in ELISAs.

f. ELISA tests- The ELISA tests offer excellent sensitivity and specificity being robust, fairly simple to perform with a minimum of equipment and readily available from a number of commercial sources in kit form. They are more suitable than the CFT for use in smaller laboratories. ELISAs are divided into two categories, the indirect ELISA (iELISAs) and the competitive ELISA (cELISAs). Most iELISAs detect mainly IgGs or IgG sub-classes. Their Main quality is their high sensitivity (97.2%) but they are less specific (97.1%), notably due to YO9 infection. These leads to devlopment of cELISAs that are more specific (99.7%), but less sensitive (95.2%) than iELISAs.

g. Fluorescence Polarization Assay- It is based on mobility of molecule in a liquid medium correlated with its mass. Small size molecules (antigen only) spin faster and depolarize a polarized light beam more, while bigger molecules (antigen antibody complex) spin more slowly and, consequently, depolarize light less. This test can be easily automated and is very quick, since after mixing the labeled antigen and serum the reading is almost instantaneous. The test sensitivity seems slightly lower than that of iELISAs. The specificity varies between 98.8% and 99.0%.

h. Skin test- This is delayed type hypersensitivity reaction and measured by the increase in skin thickness at the site of inoculation. This test is highly efficient in discriminating between true brucellosis cases and false positive serological reactions. The skin test is highly specific but its weak sensitivity makes it a good test for herds but not for individual certification.

2. Direct tests-

a. Staining – *Brucella* organism may be stained using modified Ziehl-Neelsen (Stamp) or Kosters' methods, in which they appear as coccobacillus of 0.6-1.5 µm long and 0.5-0.7 µm width. They generally occur singly and are observed in clusters of two or more. Care must be taken as other infectious agents such as *Coxiella burnetii* or *Chlamydia* may superficially resemble *Brucella.*

b. Culture-Isolation of the organism is considered the gold standard diagnostic method for brucellosis since it is specific and allows biotyping of the isolate for molecular methods. Sample can be collected either from aborted fetuses, fetal membranes, vaginal

secretions, colostrum, milk, in clinical cases of brucellosis or from the genital, oropharyngeal lymph nodes, spleen, and the mammary gland and associated lymph nodes at the time of slaughter. The identification of bacteria is based on morphology, staining and metabolic profile (catalase, oxidase, and urease). *Brucella* spp. colonies are elevated, transparent, and convex, with intact borders, smooth, and a brilliant surface. The colonies have a honey color under transmitted light. False negative results should be considered in the absence of bacterial growth since the sensitivity of culture is low.

c. Molecular methods-Polymerase chain reaction (PCR) and/its variants based on amplification of specific genomic sequences of the genus, species or biotypes enables not only identification of genus, species and biotypes of *Brucella* spp but also differentiation of virulent and vaccine strains. Nevertheless, as a general rule, brucellosis PCR techniques show a lower diagnostic sensitivity than culture methods, although their specificity is close to 100%.

d. Other tests-

- A multiplex AMOS PCR assay can identify three biovars (1, 2, and 4) of *B. abortus*, all three biovars of *B. melitensis*, all *B. ovis* biovars and biovar 1 of *B. suis*.
- A random amplified polymorphic DNA (RAPD-PCR) can identify all recognized *Brucella* spp and some newer ones.
- Real-time PCR followed by high-resolution melt (HRM) allow accurately identification of *Brucella* isolates at the species level and of unusual Brucella isolates such as BO1 and BO2.
- Polymerase chain reaction (PCR)-restriction fragment length polymorphism (PCR-RFLP) is commonly used for studies of various outer membrane protein (omp) genes.

CONCLUSION

Definitive diagnosis of brucellosis remains a difficult task. No single test is perfect, clinical history coupled with combination of two or more tests reduces diagnostic errors. Despite the vigorous attempt for more than one century to come up with a definitive diagnostic technique for brucellosis, diagnosis still relies on the combination of several tests to avoid false negative results.

REFERENCES

Corbel, M. J. (2006). Brucellosis in human and animals. WHO Press, WHO. 20 Avenue Appia, 1211 Geneva 27, Switzerland.

Geresu, M.A. and Kassa, G.M (2016). A Review on Diagnostic Methods of Brucellosis. *J Veterinar. Sci. Techno.* 7: 323

Godfroid, J., Nielsen, K. and Saegerman, C. (2010). Diagnosis of Brucellosis in Livestock and Wildlife. *Croat. Med. J. 51*(4):296–305.

Gupte, S. and Kaur, T. (2015) Diagnostic Approach to Brucellosis. *J. Trop. Dis.* 4:e109.

Vegetables as source of probiotics

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The term "probiotic" has been derived from Greek word "pro bios" which means for life. It is used to name the live microorganisms that confer beneficial effect on the host like humans and animals. Various attempts have been made by the researchers to give a concrete definition. However, the widely accepted definition by FAO defines probiotics as live microorganisms which when administered in adequate amounts confer a health benefit on the host.

What is the need for probiotics?

With an increase in the awareness among consumers for diet and good health there has been proportional rise in the demand for food that provides health benefits beyond basic nutrition. The probiotics has emerged as reliable functional food for the protection of host against harmful microorganisms and strengthening of immune system and preventing side effects of antibiotics. These play beneficial role in improved digestion, increased energy from the production of B_{12}, better breath, healthier skin, reduced cold and flu, healing from leaky gut syndrome, inflammatory bowel disease, etc. The other therapeutic benefits include reduction of hypercholesterolaemia, protection against osteoporosis, food allergy, traveller's diarrhea. They are also known to have anticancerous and antimutagenic properties.

How do probiotics work?

The mammalian gut is known to possess both beneficial and harmful bacteria. The balance of gut flora should be approximately 85 per cent good bacteria and 15 per cent bad bacteria. The imbalance in this ratio leads to dysbiosis, a condition in which there is too much of a certain type of fungus, yeast or bacteria that affects the body adversely. By consuming certain types of probiotic foods and supplements, the positive balance of microorganisms can be maintained.

TYPES OF PROBIOTICS

The bacterial strains belonging to genera *Bacillus, Bifidobacterium, Lactobacillus, Pediococcus* and some yeasts are the main candidates for probiotics. However, the two main categories are:

Lactobacillus: This is the most common type of probiotics readily available in yogurt and other fermented foods. These are particularly beneficial in diarrhea and lactose indigestion.

Bifidobacterium: It is present in some of the dairy products. It helps to ease the symptoms of Irritable bowel syndrome (IBS) and some other conditions.

Vegetables for probioitcs

The food products are fortified with probiotic cultures to label them as functional foods with enhanced nutritional values. These can be provided in both dairy products and non-dairy products. The dairy products have been considered as ideal vehicle for delivering probiotics to the human gut from ancient times. The main food matrices under this category include high viscosity fermented milk, low viscosity fermented milk (yoghurt drink, cultured buttermilk) and non-fermented products (ice-cream, milk). However, dairy products have limitations *viz.*, presence of allergens, requirement of cold environment, etc. which leads to the development of non-dairy probiotic food products from fruits, vegetables, legumes and cereals. Fruits and vegetables are considered as good food matrices being source of vitamins, minerals, antioxidants and dietary fibres. The cereals (rice, millet grains, barley, barley with malt) are widely used for preparation of probiotic beverages.

Some of the vegetables probiotics have been listed below:

Sauerkraut: It is one of the oldest traditional food made from fermented cabbage. For its preparation, fresh cabbage is shredded and mixed with 2.3-3.0% salt before allowing natural fermentation. It is high in dietary fiber and source of vitamins (A, B, C and K). It is also a great source of iron, copper, calcium, sodium, manganese and magnesium. Sauerkraut production relies on a sequential microbial process that involves heterofermentive and homofermentive LAB generally involving *Leuconostoc* sp. in the initial phase and *Lactobacillus* sp. and *Pediococcus* sp. in the subsequent phases. Sauerkraut has a variety of beneficial effects on human health. It boosts digestive health, aids circulation, fights inflammation, strengthens bones and reduces cholesterol levels.

Khalpi: This is a fermented cucumber product from Himalayan region. Ripened cucumber is cut into suitable pieces and sun dried for 2 days then put into a bamboo vessel and made air tight by covering with dried leaves. It is fermented naturally at room temperature for 3-5 days. Microorganisms isolated from khalpi are *L. plantarum, L. brevis* and *Leuconostoc fallax*. Khalpi has antiflammatory properties.

Kimchi: It is a traditional fermented Korean dish that is made from vegetables like Chinese cabbage, radish, green onions, red pepper powder, garlic and ginger. *Leuconostoc mesenteroides* and *Lactobacillus plantarum* are the predominant bacterial species in kimchi. It has various health promoting components including β-carotene, chlorophyll, vitamin C and dietary fiber. Bacteria isolated from kimchi produce beneficial enzymes such as dextran, sucrose and alcohol/acetaldehyde dehydrogenase. Because of these beneficial properties, kimchi was nominated as one of the world's healthiest foods in 2006 issue of health magazine.

Gundru: It is a non-salted, fermented and acidic vegetable product. During fermentation of gundru, fresh leaves of vegetables like ray sag, mustard leaves, cauliflower leaves and cabbages are wilted for 1-2 days then crushed mildly and pressed into a container made airtight and fermented naturally for about 15-22 days. It

is consumed as pickle and the predominant microflora of gundruk includes various LAB such as *L. fermentum, L plantarum, L casei, L casei* subsp. *pseudoplantarum* and *Pediococcus pentosaceus*.

Sinki: It is fermented radish tap root food traditionally prepared by pit fermentation which is a unique type of bio preservation of foods by LA fermentation in Sikkim. For sinki development, a pit of 2-3 ft diameter is dug in a dry place. The pit is lined with bamboo sheaths and paddy straw. Radish tap roots are wilted for 2-3 days, crushed, dipped in lukewarm water, squeezed and pressed tightly into the pit covered with dry leaves and weighted down by heavy planks or stones. The top of the pit is plastered with mud and left to ferment for 22-30 days. After fermentation, fresh sinki is removed cut into small pieces, sun dried for 2-3 days and stored at room. Besides being a good appetizer, it is effective in curing diarrhea and stomach related ailments.

Pickles: Various vegetables and fruits pickles are dietary supplements and used for culinary purposes in several parts of the word. Pickles contains vitamins, minerals, antioxidants and gut friendly bacteria. Pickles can help address vitamin K deficiency as one small pickle contains 18% of daily value of this vitamin. The consumption of LA fermented vegetable juices has increased considerably. Lacto-juices are produced mainly from cabbage, red beet, carrot, celery and tomato. For fermentation of juices of highest quality, it is imperative to use commercially supplied starter cultures for instance *L. plantarum, L bavaricus, L xylosus, L bifidus* and *L brevis*.

FUTURE PROSPECTS

The probiotics that are able to prevent and treat psychiatric illnesses responsible for changing the composition of animal gut flora are termed as psychobiotics. In the current times, depression has emerged as a potential threat to human mental health and probiotics seems to be a reliable alternative. The non-pathogenicity of probiotic bacteria can be explored for treatment of human ailments besides traveller's diarrhea.

Nematode management in protected cultivation

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SUMMARY

Nowadays the farming trend is shifting towards the protected cultivation because there lies excellent opportunity for the cultivation round the year of high value crops of fruits, ornamentals and vegetables etc. Major crops grown in polyhouses are capsicum, cucumber, tomato, carnations, melons, roses, gerbera, etc. Farmers can go for genetically modified crops and micro propagated vegetables, fruits and flower crops of high quality in bulk with limited areas. Major problems faced by polyhouse growers are of sucking pests, foliar diseases and nematodes. Among the nematodes root knot and reniform nematodes are of major concern and it very important for framers to know about the nematode symptoms, biology and its management aspects to tackle crop losses.

What is Protected cultivation: Cultivation of crops by modifying the natural environment to both shoot and roots and to achieve optimum plant growth by increasing the crop yield.

Principle: The main principle of the green houses is to create 'green house effect' whereby the major fraction of sunlight is absorbed by the plants, and plants emit long wave thermal radiations raising the green house temperature and during summer the temperature is brought down by cooling devices.

Green houses reflect back 43% of the net solar radiation incident upon it allowing the transmittance of the photosynthetically active solar radiation in the range of 400-700 nm wave length. As a result there will be less U V radiations incident upon the crop as compared to the crops grown in open field conditions.

Three types of cultivations are practiced in protected cultivation: 1) Geoponics where crops are grown directly in natural soils under greenhouse cover. In India this type is practiced. 2). Hydroponics: cultivation is done in containers having soil less medium containing peat, vermiculite, sawdust, etc. along with nutrient solutions. 3) Aeroponics: roots are grown in containers and sprayed with nutrient solutions. Various types of protected structures are available eg. Shade nets, insect proof nets, plastic low

tunnels/ row covers, plastic mulch, trend cultivation, floating plastic covers and green houses.

In protected cultivation due to continuous availability of warm, humid and abundant food and also due to absence of natural enemies makes an excellent stable environment for the nematode development. The damage level depends upon type of nematode, season and most importantly type of crop. Apart from nematodes, in protected cultivation around 20- 25 insect and mite pests have been recorded. These are aphids (*Myzus persicae*), caterpillars (*Spodoptera spp., Helicoverpa spp.*), leaf miners (*Liriomyzae* spp.), mites, thrips (*Thrips tabaci*), whiteflies (*Bemesia tabaci*). etc. Diseases like damping off, powdery mildew, cercospora leaf spot , Phytopthora etc. and other viral diseases are common.

In India due to wide cultivations in geoponic system, the main source of nematode infection are the infested soils and planting material. Major nematodes that are present in polyhouses are root knot nematode *(Meloidogyne* spp.), reniform nematode (*Rotylenchus reniformis*), lesion nematode (*Pratylenchus spp.*) etc.

Among the nematodes the root knot nematode problems is of major concern. Generally Indian farmers *i.e*. polyhouse growers skip the control of root knot nematode as these nematodes thrive in the soil and feed within the plant root tissues. The females of root knot nematode produce galls on the roots due to their continuous feeding for their growth, as a result the plants become wilted and stressed for heat, water and nutrition under severe infestations because nematode infestations reduce the flow of water and nutrients. The first stage juvenile remains inside the egg and when it reaches the second stage, juveniles hatch and start the infestations. The J2 enter into the root and moves through the tissues until its head is near the vascular cylinder. During feeding some substances are secreted in the saliva, which induce to the formation of multinucleate giant cells and galls. As a result the healthy tissues are destroyed leading to the severe dysfunction, because in this case vascular cylinder is affected and vessels becomes blocked or disrupted.

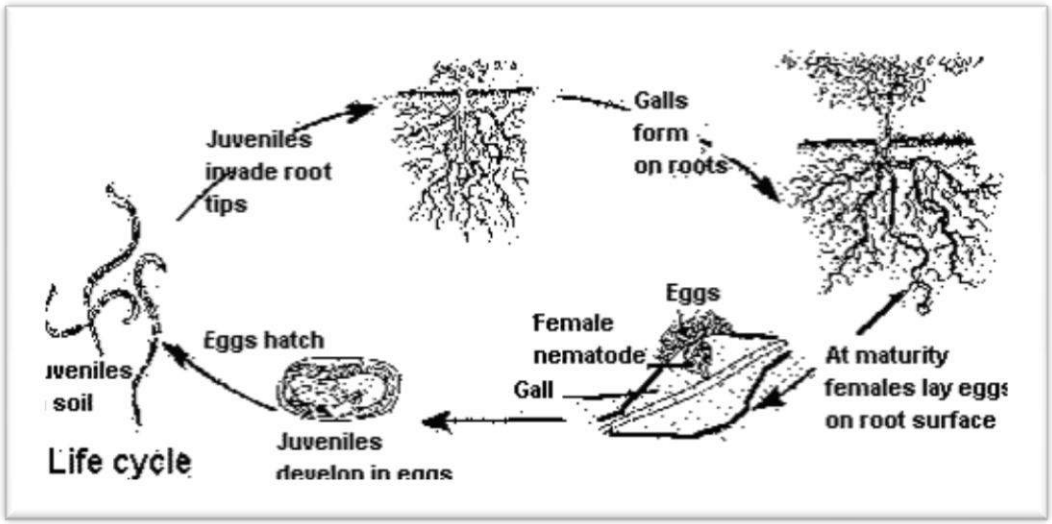

Fig 1: Life cycle of root knot nematode (Source: from google web page)

SOIL SOLARIZATION IN PROTECTED CULTIVATION AND IMPLEMENTATION OF IPM

Apart from nematodes under protected cultivation plants are infected by insects, fungi, weeds, etc. which are also soil borne like root knot nematode. Hence anaerobic soil management practices like flooding, soil solarization, etc. should be employed. Nematodes especially root knot nematodes are controlled better using organophosphorus nematicides. But application in large quantity will lead to residual problems. So, this should be replaced with less destructive and non-chemical alternative methods like soil solarization. This should be involved in package of practices *i. e.* IPM.

This method was first used in Israel in 1970 to control root knot nematode, which is now wide spread all over world. In this technique, transparent thin polythene sheets of 25-30 µm of thickness not black are laid on slightly irrigated moist soil for 6-12 weeks period to heat the non-cropped soils and make the temperature lethal to nematodes. Polythene reduces the heat convection and water evaporation from the soil to the atmosphere. This forms the water droplets on the inner surface of the polythene film as a result its transmittivity to the long wave is highly reduced, resulting in better heating which will increase the thermal sensitivity of resting structures. This approach is farmer friendly because this method is cheap, easy possessability, excellent chemical resistant, flexible, tough, free from odor and toxicity. Control by solar heating is high in upper 30 cm of the soil and is very effective for shallow rooted and short season plants. As a result this technique is not effective for those nematodes which are residing in deeper soils i.e. below 12 inches soil because nematodes are mobile and can recolonize soils quickly. Hence nematode management therefore requires yearly application.

Fig 2: Soil Solarization and mulching in polyhouses.

Low application of fungicides, herbicides, etc. can be combined with soil solarization to achieve better pest control. The elevated temperatures seem to be increase the activity of the above active compounds. It can also be combined with the application of crop residues, green and animal manures and inorganic fertilizers. These materials will release the volatile compounds in the soil that kill the pests by stimulating the growth of beneficial soil organisms. eg, root knot nematode can almost be completely controlled by combining the above two techniques resulting in larger yields.

Sanitation:

At present no chemical management tactics are available that can resolve the problems within the green houses once the nematodes are introduced. Hence when early symptoms are first noticed then immediately the infected seedlings or plants should be rouged out. Other sanitation practices includes rapid destruction of infested crop roots system quickly after harvest and burning them at distant places, sterilizing the hands, shoes, boots, tools, equipment, etc. at the entry points of polyhouses. Also clean uncontaminated water should be used for irrigation.

Site selection for protected cultivation

Site selection is most crucial step for taking up the protected cultivation. Fungal diseases and sucking pests are more at places with more rainfall and high humidity and wind velocity. As far as nematodes are concerned the soil should be tested before the construction of new polyhouses. Well drained soils with good percolation capacity are suitable for growing the vegetable crops in polyhouses. The type of soil plays a very important role in the occurrence of nematode and disease complex *e.g*., coarse particle soils increase the synergistic interactions between root knot nematodes and certain fungi. Green houses should be situated to avoid introduction of nematodes via downstream movement of drainage or run off water and soil.

Also, preliminary sampling prior to the harvest in established polyhouses or after destruction of the previous crop is necessary for quantifying the nematode population otherwise this type problems develops in newly planted crops because at present no post plant corrective measures are available to rectify the problems completely once established. The sample will be consisting other nematode genera and accordingly the control recommendations can be formulated. Hence nematode density and distribution within the selected area must therefore be accurately determined before planting. It is especially important to guarantee to testing officer that a representative sample is collected from the same field. If the sample is positive for root knot or reniform nematode then at least the growers can opt for resistant cultivars, non host crops, or go for rotation schemes.

Sampling:

Since root knot nematodes are concentrated in the crop rooting zone, samples should be collected to a soil depth of 5 to 12 inches and sample should be taken only in that place where soil moisture is appropriate avoiding extremely dry or wet places. Growers can also submit the roots and soil cores from 10 to 20 suspect plants avoiding dead and dry plants as they contain only few nematodes. They can also submit additional samples from the adjacent areas of good growth for comparative analysis. Once all the samples are collected from the single location, the entire samples are pooled carefully in the plastic covers/ bag with proper labeling along with the details of previous operations and crops undertaken on same area. Polythene bags will prevent the drying of the sample and the sample will remain intact. Also it should not be subjected to freezing or overheating, drying and exposure to sunlight. Always sample should be submitted fresh immediately to the commercial laboratory. And in the laboratory the samples should be stored in refrigerator if needed.

Crop rotation

Crop rotation is very effective in open field conditions because farmers have wide options to go for non-host crops. But with polyhouse growers the option of crop rotation do not fit because they have limited choice of crops and the crops which are chosen are highly renumerative. This method is effective only if the crops selected are unsuitable for nematode infection. Root knot nematode have a wide host range and the growers are left with little option for selecting the non host crops. Still to escape from the menace of root knot nematode they can go for crops like marigold, capsicum, etc.

Fallowing during the off season is probably the single most effective cultural control measure available with polyhouse growers. As roots are not readily available, the soil population densities decline gradually due to starvation.

Flooding

Extended periods of off season, fields flooding can promote the decline of soil population density of nematodes in production fields. Alternate two to three week cycles of flooding and drying has proven to be more effective.

Chemical control:

Fumigants like Dazomet, metham sodium are highly effective components that release methyl isothiocyanates in soil. But this are not registered and require frequent irrigations and leave behind the residual problems. Non fumigants like Aldicarb, Oxamyl, Fenamiphos, Prophos, carbofuran etc. are some of the nematicides but they result in high phytotoxic effects on plants.

Soil treatment or drenching with carbofuran 3G @ 6 g/sq. m or captan 2 g/L of water is recommended for combating root knot nematode problems (Technical bulletin, NCIPM).

Fig. 3: Tomato roots infected with root knot nematode in protected cultivation

Integrated methods like augmentation of bioagents vide fortified FYM (Store FYM under shade, mix bioagents such as *Trichoderma harzianum* culture (c.f.u. 2 x 10^9/g) @ 1 kg/500 kg of FYM and/or *Pseudomonas fluorescens* (c.f.u. 2 X 10^{12} cells/ml) 1 L/500 kg FYM and mixing it with FYM one month before bed preparation.

Such enriched FYM may be used at the time of preparing planting beds (Technical bulletin, NCIPM).

Fig. 4: Roots of cucumber plant infested with infested with root knot nematode nematode

Fig. 5: Cucumber plants in polyhouse infested

FUTURE THRUST

Fig 6: Gerbera infested with root knot nematode in polyhouse

Crop failure in polyhouses is not due to single pathogen, but due to interaction with community of pathogens, hence control measures should be adopted which are quite effective against all the soil borne pathogens occurring in the cropped soils. Hence, the IPM schedules designed for particular cropping and pest or diseases in polyhouse systems should include nematode management options like nematode resistant varieties, healthy seedlings, periodic monitoring for nematode infestations from sowing to harvesting stages, sanitation and proper exploitation of bioagents. Due to increase in thrust of intensive cultivation, role of plant parasitic nematode as biotic constrain needs due consideration while planning any IPM module primarily as exclusion or avoidance along with other pest and diseases.

Mega Food Parks in India: To uplift Farmers Income and Employment opportunity

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Nowadays, India is the fastest growing economy in the world and is home to over 1.3 billion people. The country's rising disposable income has fueled the growth of the world's largest consumer market. India is amongst the largest producers of food in the world. India is occupied 1st position in milk production and 2nd largest producer of fruits, vegetables, fish producer in the world. The nation has an abundant source of raw material base for the food processing industry. Nevertheless, less than 2-5% of the country's natural produce is processed due to lack of processing facilities, infrastructure and technology. Almost 25-30 per cent of agriculture produce is estimated to be wasted in the absence of proper processing mechanism. Only 7 per cent of the total Indian perishable produce is processed, which is extremely low compared to countries such as the US (65 per cent) Philippines (78 per cent) and China 23 per cent). Become conscious the need for improving capacity of the food processing industry, the government has taken several initiatives to stimulus the growth of the sector. One of the significant initiative is Mega Food Parks scheme with the view to establish mega food clusters in India. 'Mega Food Parks' scheme it is based on the cluster approach for developing food processing industries. Mega Food Park is to provide modern infrastructure facilities for the food processing along the value chain from the farm to the market.

What is a Mega Food Park?

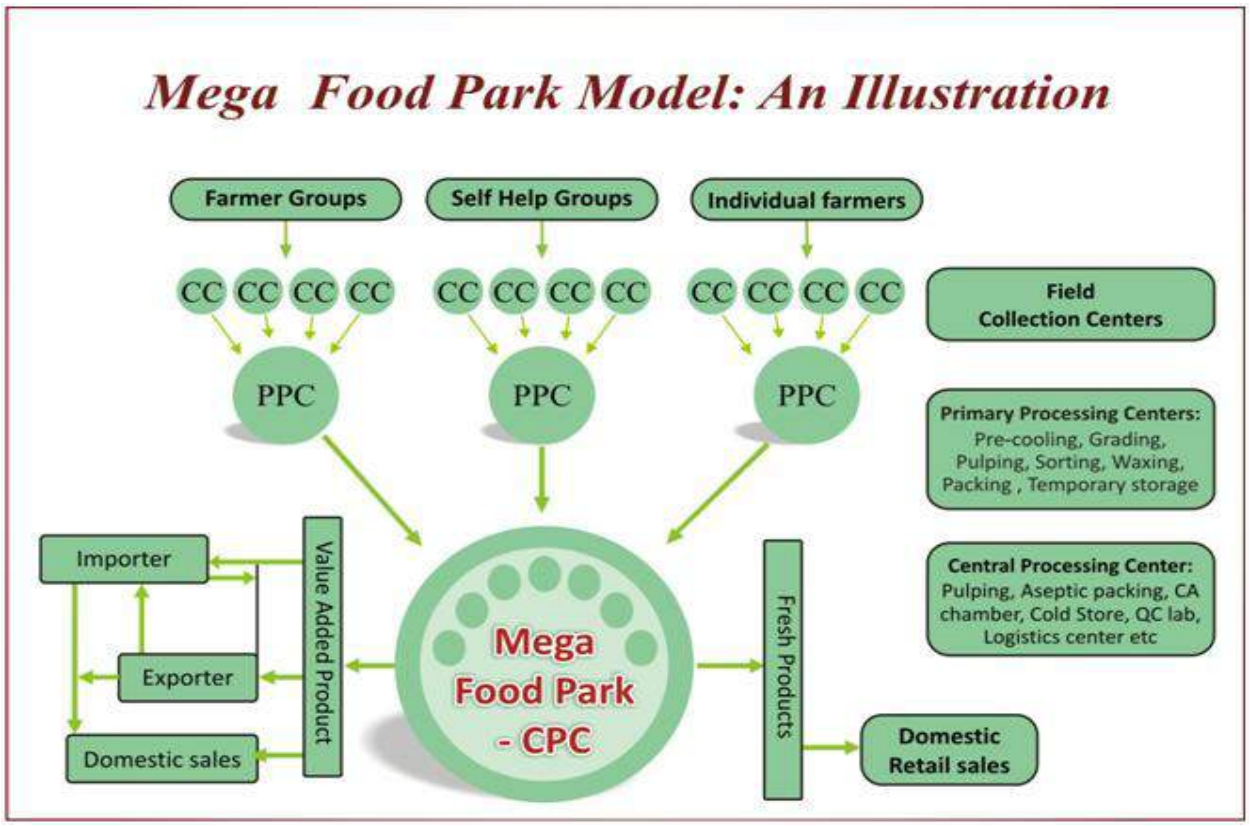
To give a major boost to the food processing sector by adding value and reducing food wastage at each stage of the supply chain with particular focus on perishables, Ministry of Food Processing Industries is implementing Mega Food Parks Scheme in the country. Mega Food Parks create modern infrastructure facilities for food processing along the value chain from farm to market with strong forward and backward linkages through a cluster-based approach. Common facilities and enabling infrastructure is created at Central Processing Center and facilities for primary processing and storage is created near the farm in the form of Primary Processing Centers (PPCs) and Collection Centers (CCs).Under the Scheme, Government of India provides financial assistance upto Rs. 50.00 Crore per Mega Food Park project.

Collection Centers (CCs)

The CCs work as points of aggregation of the produce from individual farmers, farmer's groups and Self Help Groups. They feed the raw material to the PPCs. The collection centres are managed by local entrepreneurs. They are server as farm level aggregation points for adjoining areas within a radius of around 10 kilometres. It was expected that these CCs will emerge as centres of rural commerce and will spur economic activities in the area.

Primary Processing Centers (PPCs)

The PPCs work has primary handling centres which use the raw materials to be processed further in CPC. A PPC serves a number of CCs in proximity. Some PPCs have inhouse facilities such as pulping, juicing etc. They have facilities such as refrigerated vans, trucks etc. to transport material to CPC in shortest possible time.



CENTRAL PROCESSING CENTRE

The Central Processing Centre is an industrial park in an area of around 50 acres and houses a number of processing units owned by different business houses. Here, the developed plots of land will be provided to the large and midsized units while Common Design Factory Sheds are provided to small scale units. The park will provide common facilities such as water, electricity and effluent treatment apart from specialized facilities like cold storage, ware housing, logistics and backward integration through the network of primary processing centers and collection centers.

Thus, Mega Food Park is an inclusive concept that aims at establishing the direct linkages from the farm to processing to consumer markets. The cornerstone of a Mega Food Park's success is efficient logistics that connects the CCs and PPCs to CPC. Further, the main feature of this scheme is cluster based approach.

HISTORY OF MEGA FOOD PARKS IN INDIA

It was on 10th July 2012 when India's first Mega Food Park - Srini Food Park, was inaugurated by the then union agriculture minister Sharad Pawar at Chittoor in Andhra Pradesh – the largest fruits and vegetables cluster in India. From seed to shelf, Srini Food Park facilitates end-to-end food processing with beneficial forward and backward linkages. On par with software parks, this new-age or world-class facility in a sprawling 147-acre space has been equipped with modular cold storage, advanced testing laboratories, state-of-the-art facility for pulping, bottling, IQF, tetra packing, and warehousing facilities and advanced testing lab. It offered supply chain infrastructure, cluster farming backed by field collection centre, self help groups and individual farmers. Today it has emerged as an ideal destination for food processing units. Even the Mega Food Park at Tumkur that Modi inaugurated is spread across 110 acres. With 22,000-tonne storage capacity, 30 food processing companies are expected to generate 4000 jobs besides benefiting farmers from the adjoining districts of Kolar, Shimoga and Tumkur, which are rich in vegetables, fruits, millets, and oilseeds.

IMPORTANT FEATURES OF MEGA FOOD PARKS

- Cluster Based Approach
- Demand driven with focus on strong backward and forward integration
- Enabling Infrastructure Creation along the supply chain and technology
- Creation of Central Processing Centre (CPC) and Primary Processing Centres (PPC)
- Common Facilities and amenities to be assisted
- Leverage investments in food processing units

- Stakeholder participation with private led initiative through Special Purpose Vehicle (SPV)
- Assistance to creation of common enabling facilities
- Typical Project Cost envisaged – Rs 120-150 crore
- Land – not eligible for funding out of GOI grant
- Assistance from Ministry
- Limited to non-land component of the project and project is done on 50-50-50 scheme {Rs. 50 Crore grant by Government; 50 acre land is needed; 50 crore minimum investment to be done by park developer}
- 50% of project cost limited to Rs. 50 Crore in general areas
- 75% of project cost limited to Rs. 50 Crore in difficult & hilly areas and ITDP notified areas.
- Mega Food Parks, with their immense potential for expansion, can help India meet the food demands of future.

KEY MEGA FOOD PARKS IN INDIA

Currently, 9 Mega Food Parks, namely, Patanjali Food and Herbal Park, Haridwar, Srini Food Park, Chittoor, North East Mega Food Park, Nalbari, International Mega Food Park, Fazilka, Integrated Food Park, Tumkur, Jharkhand Mega Food Park, Ranchi, Indus Mega Food Park, Khargoan, Jangipur Bengal Mega Food Park, Murshidabad and MITS Mega Food Park Pvt Ltd, Rayagada, Orissa are functional. Recently, foundation stones for two new Mega Food Parks were laid in Kerala.

PROCEDURE OF MPFS IMPLEMENTATION

Implementation of the Mega Food Park is done through the Special Purpose Vehicle (SPV) mechanism in which Financial Institutions/Banks, organized retailers, processors, service providers, producers, farmer organizations and other related stakeholders are the equity Holders. Each SPV is a Company registered under the Companies Act; and is required to have at least three entrepreneurs / business units which would be independent of each other with no common directors. The land for the project is arranged by SPV.

- A minimum of 26% of equity of the SPV should be held by food processor(s) within the SPV.
- The combined net worth of the shareholders of the SPV should be minimum 50 Crore with food processor(s) having at least of Rs. 10 Crore of net worth.
- The earlier guidelines said that the government agencies can become shareholders and they can have maximum 26% share capital, so that SPV's private sector character is maintained. The NDA government had recently modified the guidelines to allow central government agencies to become shareholders in the Special Purpose Vehicles (SPVs) to run food parks without any restriction on their equity.
- The SPVs need to bring in at least 20% of the project cost, including the cost of land, as their contribution.

PATTERN OF GOVERNMENT ASSISTANCE

The Mega Food Parks Scheme (MFPS) envisages a onetime capital grant of 50% of the project cost (excluding land cost) subject to a maximum of Rs. 50 crore in general areas and 75% of the project cost (excluding land cost) subject to a ceiling of Rs. 50 crore in difficult and hilly areas i.e. North East Region including Sikkim, J&K, Himachal Pradesh, Uttarakhand and ITDP notified areas of the States. A Program Management Agency (PMA) is appointed by the Ministry to provide management, capacity building, coordination and monitoring support. For meeting the cost of the above and also other promotional activities by the Ministry, a separate amount, to the extent of 5%of the overall grants available, is earmarked.

ROLE OF STATE GOVERNMENT

- Providing assistance to SPVs in procurement of suitable land.
- Providing all the requisite clearances, wherever needed, for setting up the MFP and its components thereof and providing the necessary assistance for Power, Water, Approach roads and other external infrastructure to the project
- Providing flexible and conducive labour environment and consider special facilities like exemption of stamp duty, VAT/Sales Tax exemption etc. for the MFP and the units located in the MFP
- Providing a fast track single window agency to facilitate clearances and permissions required for the project.

HIGHLIGHTS OF SCHEME

- Government provides grants up to Rs 50 crores for each food park to be implemented by a consortium of companies.
- 30-35 food processing units are expected to be established.
- Collective investment of companies is expected to be at least 250 crores.
- Annual turnover of Rs 400-500 crore and employment generation of at least 30000 from each mega food park is expected.

Economics of Mega Food Parks

The Indian food processing industry is at present growing at the rate of seven per cent and it is expected to grow from US$ 200 million in 2008 to US$ 310 million in 2015 with the highest growth being recorded in the Fruits and Vegetables sector (20 percent). Another study by McKinsey & Company suggests that the Indian food market is poised to grow to $310 billion by 2015 and $ 344 billion in 2025. In coming years, Mega Food Parks will generate colossal revenue for the industry and the farmers and will surely boost the food processing industry in the country. The expected outcome is creation of high quality processing infrastructure, reduction in wastage, capacity building of producers and processors and creation of an efficient supply chain along with significant direct and indirect employment generation

CURRENT STATUS

When this scheme was launched; 42 Mega Food Parks were to be established by 2015; as of now not all of them have been launched. A sanction of 42 food parks has been planned, out of which 25 in various states have already been sanctioned with 17

pending; expression of interest is available from companies with the government. According to the Government, as of October 2016, 8 mega food parks have become operational and all 42 would be operational in the next 2 years. The government is now planning to launch a revamped version of the scheme under SAMPADA (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters).

Objective

- To increase processing of perishables crops
- To increase India's Share in global food trade
- To establishing a "direct linkage from farm produce to processing market (processors and retailers) and then to consumer markets" through a network of collection centres and primary processing centers
- To check agricultural wastage by providing necessary infrastructure facilities
- To reduce wastage of perishables; rise processing of food items from 6% to 20% and raise India's share in Food Processing Industry from 1.5% to 3%
- Providing a mechanism to link agricultural production to the market by bringing together farmers, processors and retailers so as to ensure maximizing value addition, minimizing wastage, increasing farmers' income and creating employment opportunities particularly in rural sector
- To provide high quality food processing infrastructure near the farms. These included logistics, transportation, and central processing centres so as to ensure –
- Direct as well as indirect employment generation in rural areas
- Exposing farmers to a more systematic, market driven and profitable farming activities
- Generation of additional income for the farmers
- Reduction in post harvest losses
- Maintenance of value chain from the farm to the market

MAJOR ISSUES

There are some major issues which need to be addressed to get the desired results.

- ✓ Firstly, land acquisition is major issue. It is very difficult to get 50 acre of land anywhere, particularly in small and hilly states. The government needs to provide flexibility to this requirement.
- ✓ Secondly, since most agri-business in our country happens through cooperatives, their integration into food parks is critical.
- ✓ Thirdly, through the scheme gives a grant to the SPV, the SPV finds itself unable to attract the PPCs and CCs. Here, the National Mission on Food Processing could play a major role by providing the Rs. 50 Lakh grant under that mission to units within the MFPs. But that scheme is now delinked from central support and states may have to decide if they want to continue or not. State governments may look into these issues case-by-case basis and provide attractions to these units as well.
- ✓ Fourthly, the MFP scheme provides maximum grant of Rs.50 crores for setting up a MFP in minimum 50 acres of contiguous land with 50 percent contribution to the

total project cost from the SPV. This "one size fits all" approach has not been able to attract the investors having more or less requirements.

- ✓ Lastly, the scheme has not attracted global companies because some of them would not work on basis of "grant" from a developing country. They would like to work on Joint Ventures.

MEGA FOOD PARKS PROVIDE A FILLIP TO THE FARM SECTOR

The total food production in the country is likely to be doubled in next decade or so. Yet at present the country accounts for less than 1.5 per cent of international food trade and lack of processing facilities means that there is wastage of about 35 per cent of the agricultural produce worth about US $10 billion. It is in this backdrop that food parks have become a necessity to provide the crucial link between the farmers and traders. Studies have shown that the food processing industry has an untapped domestic market of one billion consumers in the country, and hence has been accorded the status of priority sector in the new trade policy of the government. It was in September 2008 when the then Cabinet Committee on Economic Affairs approved the Food Park scheme. Its aim was to encourage public-private partnership in creating rural infrastructure in food processing sector and the scheme was taken up under the 10th five-year plan. However, it was revised and renamed as Mega Food Park scheme for the 11th Five Year Plan Period to meet the requirement of the Vision 2015 of the Ministry of Food Processing Industries. The government has thus far sanctioned 42 Mega Food Park projects throughout the country. And 25 of them are being implemented in various states. For the remaining 17, which are expected to attract investments to the tune of Rs. 2,100 crore, the government has received 72 expressions of interest.

REFERENCE

Atul Saxena, (2017). Ministry of Food Processing Industries (MOFPI). Panchsheel Bhawan, August Kranti Marg, New Delhi-110049.

Deepak Parvatiyar (2014). Mega Food Parks: How will they benefit the Indian Economy? *Elections.in*. 2014-09-26. Retrieved 2016-07-26.

K Halder, N Kumar and P S Minz (2015). Potential location for setting up of food parks *Fnbnews.com. Retrieved 2016-07-24.*

http://economictimes.indiatimes.com/industry/cons-products/food/all-42-mega-food-parks-to-be-operational-in-2-years-harsimrat-kaur-badal/articleshow/55092028.cms

https://en.wikipedia.org/wiki/Mega_Food_Parks

http://www.elections.in/blog/mega-food-parks-how-will-it-benefit-the-indian-economy/

Potato black scurf disease and management (Rhizoctonia Solani)

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Potato (*Solanum tuberosum* L.) is an annual, herbaceous, dicotyledonous plant of family *Solanaceae*. It is originated in "environs" of lake Titicaca high in the Peru and Bolivia in South America. Potato cultivation has its record as early as in 8000-6000 B.C. P. It is fourth most important food crop of the world after rice, wheat and maize. Potato is infected by many diseases of fungal, viral and bacterial in origin. Important fungal diseases are late blight (*Phytophthora infestans*), early blight (*Alternaria solani*) , Phoma leaf spots (*Phoma andigena* var. *andina*), Pink rot (*Phytophthora erythroseptica*), Charcoal rot (*Macrophomina phaseolina*) and black scurf (*Rhizoctonia solani).* Black scurf caused by *Rhizoctonia solani* Kuhn (*Thanetophorus cucumeris*)(Frank, 1980) is a soil born fungus disease of potato worldwide. It is distributed in India in varied proportions and is a major problem in field wherever potato is grown year after year in the same field. Rhizoctonia stem canker and black scurf disease of potato are caused by fungus *Rhizoctonia solani* and can be found on all underground parts of the plant at various times during the growing season. *Rhizoctonia solani* (Deuteromycetes, Mycelia Sterilia) is a species complex of 13 anastomosis groups (AGs), which are categorized according to the ability of their hyphae to anastomose (fuse) with one another. *R. solani* causes black scurf on tubers and stem and stolon canker on underground stems and stolon, and it occurs wherever potatoes are grown. Losses from *Rhizoctonia* mainly occur when the weather is cold and wet in the weeks following planting. Poor stands, stunted plants, reduced tuber number and size, and misshapen tubers are symptoms of *R. solani* infection.

SYMPTOMS

Presence of brownish black sclerotia on tubers is the most common symptom. The sclerotia are superficial and are not easily removed by washing the tuber. They may be minute structures or may cover the greater part of the tuber. Diseased seed-tubers on germination may develop sprouts that may be attacked and killed by fungus resulting in gappy germination.

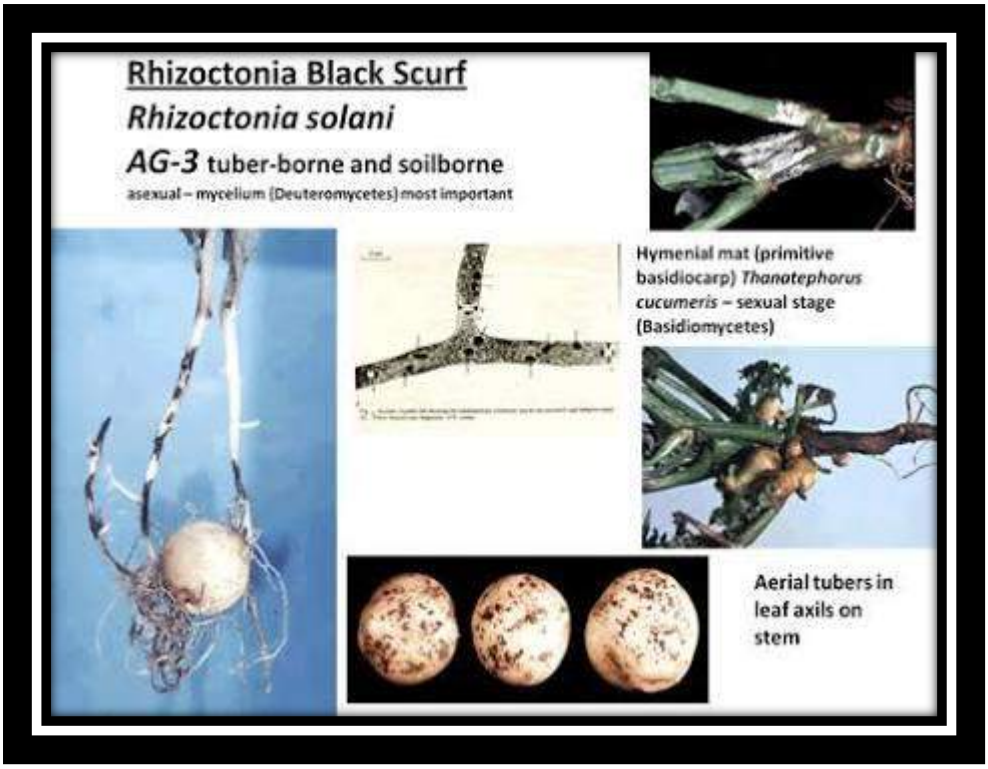

Fig.1. Shows black scurf disease in potatoes

The symptoms of the disease are found on the both the above and below ground portions of the plant. Black scurf is the most obvious sign of Rhizoctonia disease. In this phase of the disease, the fungus forms dark brown to black, hard masses on the surface of the tuber. These are called sclerotia and are resting bodies on the fungus. Rhizoctonia sclerotia are usually irregularly shaped and range from small, flat, barely visible blotches to large, raised lumps.

Although black scurf is the most noticeable sign of *Rhizoctonia*, stem canker is the most damaging component of the disease. Early in the season, the fungus attacks germinating sprouts underground before they emerge from soil. Sprouts may be killed outright if lesions form near the growing tip. Damage at this stage results in delayed emergence and is expressed as poor and uneven stands with weakened plants. Reduction in crop vigor results from expenditure of seed energy to produce secondary or tertiary sprouts to compensate for damage to primary sprouts.

Occasionally, heavily infested potato seed tubers are unable to produce stems. Instead, the tubers produce stolons with several small tubers. This symptom, referred to as “no top” can be confused with the same symptom caused by physiologically old seed that has been desprouted.

DISEASE CYCLE

Rhizoctonia stem canker and black scurf can be initiated by seed-borne or soil-borne inoculum. The pathogen overwinters as sclerotia and mycelium on infected tubers, in plant residue, or in infested soils. When infected seed tubers are planted in the spring, the fungus grows from seed surface to the developing sprout, and infection of root primordia, stolon primordia, and leaf primordia can occur. Seed-borne inoculum is

particularly effective in causing disease because of its close proximity to developing sprouts and stolons.

Mycelia and sclerotia of *R.solani* are endemic to soils, living on organic debris, and can cause disease independently or in conjuction with seed borne inoculums. Soil borne inoculums is potentially as damaging as seed borne inoculums, bit it can cause infection only when the plant organs develop in proximity to the inoculums. Roots and stolons may be attacked anytime during the growing season, although most infections probably occur in the early part of the plant growth cycle.The plants resistance to stolon infection increase after emergence, eventually limiting expansion of lesions.

Previous research has shown that soil temperature is a critical factor in the intiation of Rhizoctonia disease in potato, the temperature range for growth of *R. solani* AG-3 is 41 F to 77 F, so plants will be most suspectible to infection when the soil temperature are within this critical range. Cool temperature, high moisture, fertility and a neutral to acid soil(Ph 7 or less) are thought to favor development of Rhizoctonia disease of potato.

MONITORING AND CONTROL

Currently, it is not possible to completely control Rhizoctonia disease, but following a combination of cultural and crop protection strategies may limit their severity. Effective management of this disease requires implementation of an integrated disease management approach and knowledge of each stage of disease. Although, the most important measures are cultural, chemical controls should also be utilized. To date, there have been no comparisons of the relative susceptibility of potato varieties currently grown.

BIOLOGICAL CONTROL

There is growing evidence that a biofumigation treatment from incorporating a mustard cover crop is way to reduce Rhizoctonia incidence. When incorporated into the soil, mustard residuces release cyanide containing compounds that fumigate the soil.

CHEMICAL CONTROL

1. SEED AND SOIL TREATMENT: Several products have been developed specifically for control of seed-borne potato disease and offer broad-sepctrum control for *Rhizoctonia solani* Black scurf of potato.

- Boric acid @ 3% Tuber seed treatment is effective against black scurf of potato.
- Thifluzamide 24% SC @ 3.0 ml/10 kg seed tubers is effective against black scurf of potato by slurry treatment.
- Tuber treatment with MEMC (Organomercury) & soil application of 30 kg per ha are most effective.
- Treating the soil with pentachloronitrobenzene besides tuber treatment provide very satisfactory control of the disease (Thirumalachar1953).

2. IN- FURROW FUNGICIDE APPLICATION: In furrow application of fungicide at planting has resulted in significant improvement in control of Rhizoctonia disease of

potatoes. Products such as Monocut and Quadris applied in furrow at planting have given consistent and excellent control of Rhizoctonia disease of potatoes in trials at MSU.

REFERENCES

Agrios, G.N. (2005) Plant Pathology. 4th Edition. Academic press, London, New York. p. 124

Frank, J.A., and Leach, S.S., 1980. Comparison of tuberborne and soilborne inoculum in the Rhizoctonia disease of potato. *Phytopatho***70**, 51–53.

MSU Extension bulletin E2896, http://web4.msue.msu.edu/veginfo

Thirumalchar,(1953) Management of black scurf *Rhizoctonia solani* of potato through soil and seed treatment with chemical. *Phytopath,* **43**: 645.