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State Hunger Index: A Comparative Study of Hunger Across Indian States

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ABSTRACT

The study focused attention to the problem of hunger and malnutrition in India at the state level through development of an index. In addition to that, relationship between Hunger Index and socio-economic indicators was also studied. In order to fulfill the first objective, secondary data related to Hunger Index indicators viz. Infant mortality rate, proportion of calorie undernourishment and prevalence of underweight were collected for the year 2018 from NITI Aayog. Arithmetic mean of three indicators was computed in order to obtain hunger index score. The mean scores ranged from 15 – 43. As per the index scores obtained, the states/ UTs were categorized according to the severity of hunger viz. low (≤9.9), moderate (10 – 19.9), serious hunger (20 – 34.9), alarming (35 – 49.9) and extremely alarming (>50). The results indicated that the state Kerala had comparatively less severity of hunger (15.3) and thus categorized under "moderate" followed by Goa (17.3), Pondicherry (18.6), Nagaland (19.1) and Sikkim (19.9); Besides, states such as Bihar (43.4), Uttar Pradesh (42.9), Jharkhand (40.7) and Rajasthan (38.9) were categorized under "alarming" category. Remaining states/UTs had fallen under "serious hunger" category. To accomplish the second objective correlation analysis was incorporated to find the relationship between Hunger Index and socio-economic indicators viz. growth rate (2018) and poverty rate (2018). The results revealed that poverty rate and growth rate is highly correlated with Hunger Index. While there existed a positive relationship between Hunger Index and poverty rate, the relationship between Hunger Index and growth rate was negative.

Key words: Hunger, food security, malnutrition, GHI, stunting and wasting

INTRODUCTION

Hunger is amisery coupled with lack of enough calories. The Food and Agriculture Organization (FAO) defined hunger as the consumption of too few calories to provide

the minimum amount of dietary energy that everyone requires to live a healthy and productive life, given that person's age, stature and physical activity level. The problem of hunger is complex and different terms are used to describe its different forms viz. undernutrition and malnutrition. Undernutrition is the outcome of inadequate intake of food in terms of either quantity or quality, poor utilization of nutrients due to infections or other illnesses, or a combination of these factors; whereas malnutrition refers more generally to both undernutrition (caused by deficiencies) and overnutrition (caused by unbalanced diets).

India, with a population of over 1.3 billion, has seen an incredible growth in the past two decades. Gross Domestic Product has increased 4.5 times and per capita consumption has increased 3 times. Similarly, food grain production has increased almost 2 times. Despite phenomenal industrial and economic growth and while India produces sufficient food to feed its population, it is unable to provide access to food to a large number of people, especially women and children."The State of Food Security and Nutrition in the World, 2018" reported that 195.9 million people are undernourished in India. By this measure 14.8 percent of the populace is undernourished in India. Also, 51.4 percent of women in reproductive age between 15 to 49 years are anemic. Further according to the report 38.4 percent of the children aged fewer than five in India are undersized (too short for their age), while 21% suffer from wasting, meaning their weight is too low for their height. Malnourished children have a higher risk of death from common childhood illnesses such as diarrhea, pneumonia, and malaria.

Although hunger is most unswervingly manifested in inadequate food intake and lack of a proper diet, especially in amalgamation with low birth weights and highrates of infections can result in stunted and underweight children. The most extremesymptom of continued hunger and malnutrition is mortality. The Global Hunger Indexrecognizes the interconnectedness of these dimensions, and therefore, captures performanceon all three of them in how it is constructed. The index has been an effective encouragement toolwhich has brought the issue of global and national hunger to the front in policy debates,particularly in developing countries. The ranking of nations on the basis of their index scores hadbeen a powerful tool to help focus attention on hunger, especially for countries like India whichunder-perform on hunger and malnutrition relative to their income levels.

India has constantly ranked disappointingly on the Global Hunger Index. The Global Hunger Index 2008(von Grebmer *et al*. 2008) reveals India's continued uninspiring performance at eradicatinghunger; The Global Hunger Index 2018 ranked India at 103 out of 119 countries on the basis of three leading indicators -- prevalence of wasting and stunting in children under 5 years, under 5 child mortality rate, and the proportion of undernourished in the population.

The Global Hunger Index

The Global Hunger Index is a tool designed to broadly measure and track hunger at global, regional and national levels. GHI scores are calculated each year to assess progress and setbacks in fighting hunger. The GHI is intended to raise awareness and

understanding of the struggle against hunger, provide a way to compare levels of hunger between countries and regions, and call attention to those areas of the world where hunger levels are highest and where the need for additional efforts to eliminate hunger is at its peak.

Objectives

- To focus attention to the problem of hunger and malnutrition at the state level through the development of an index that enables comparisons within India.
- To find the relationship between Hunger Index and socio economic indicators.

Data and Methodology

The Hunger Index scores werecomputed using a three-step process that draws on available data from various sources to capture the multidimensional nature of hunger.

First, for each state, values are determined for three indicators (obtained from NITI Aayog, 2018):

1. **UNDERNOURISHMENT:** the share of the population that is undernourished (that is, whose caloric intake is insufficient)
2. **UNDERWEIGHT:** the share of children under the age of five who are wasted (that is, who have low weight for their height, reflecting acute undernutrition)
3. **INFANT MORTALITY:** the mortality rate of children under the age of five (in part, a reflection of the fatal mix of inadequate nutrition and unhealthy environments). Source: Wiesmann D. (2004)

Second, each of the three component indicators was given a standardized score on a 100-point scale based on the highest observed level for the indicator.

Third, standardized scores were aggregated to calculate the Hunger Index score for each state, with each of the three dimensions (infant mortality rate, calorie undernourishment and prevalence of underweight) given equal weight.

A value of 0 would mean that a state had no undernourished people in the populace, no children younger than five who were wasted or undersized, and no children who died before their fifth birthday. A value of 100 would signify undernourishment, underweight, and mortality levels each at approximately the highest levels observed. The India State Hunger Index Severity Scale shows the severity of hunger - from low to extremely alarming associated with the range of possible HI scores as given below:

Table 1: Hunger Index Severity Scale

Range	Severity
≤ 9.9	Low Hunger
10 – 19.9	Moderate Hunger
20 – 34.9	Serious Hunger
35 – 49.9	Alarming Hunger
>50	Extremely Hunger

Results and Discussion

India State Hunger Index was computed by taking average of the three above mentioned indicator scores viz. Infant mortality rate, proportion of underweight and prevalence of calorie undernourishment. Once the scores are calculated, and then the states are ranked based on those scores. Lesser the index score, better the performance of the state. The state wise hunger index score and their ranks are tabled below.

Table 2: Hunger Index Scores and their Ranks – State wise

State/UT	Infant mortality rate	Underweight	Calorie undernourishment	Hunger Index 2018	Rank
Andhra Pradesh	34.0	31.9	31.4	32.4	23
Arunachal Pradesh	36.0	19.5	29.4	28.3	16
Assam	44.0	29.8	36.4	36.7	26
Bihar	38.0	43.9	48.3	43.4	33
Chhattisgarh	39.0	37.7	37.6	38.1	29
Delhi	18.0	27.0	32.3	25.8	14
Goa	8.0	23.8	20.1	17.3	2
Gujarat	30.0	39.3	38.5	35.9	25
Haryana	33.0	29.4	34.0	32.1	21
Himachal Pradesh	25.0	21.2	26.3	24.2	12
Jammu & Kashmir	24.0	16.6	27.4	22.7	9
Jharkhand	29.0	47.8	45.3	40.7	31
Karnataka	24.0	35.2	36.2	31.8	19
Kerala	10.0	16.1	19.7	15.3	1
Madhya Pradesh	47.0	23.4	42.0	37.5	27
Maharashtra	19.0	42.8	34.4	32.1	20
Manipur	11.0	36.0	28.9	25.3	13
Meghalaya	39.0	13.8	43.8	32.2	22
Mizoram	27.0	29.0	28.0	28.0	15
Nagaland	12.0	16.8	28.6	19.1	4
Odisha	44.0	34.4	34.1	37.5	28
Punjab	21.0	21.6	25.7	22.8	10
Rajasthan	41.0	36.7	39.1	38.9	30
Sikkim	16.0	14.2	29.6	19.9	5
Tamil Nadu	17.0	23.8	27.1	22.6	8
Telangana	31.0	28.5	28.1	29.2	17
Tripura	24.0	24.1	24.3	24.1	11
Uttar Pradesh	43.0	39.5	46.3	42.9	32
Uttarakhand	38.0	26.6	33.5	32.7	24
WestBengal	25.0	31.5	32.5	29.7	18
Andaman&Nicobar	16.0	21.6	23.3	20.3	6
Chandigarh	14.0	24.5	28.7	22.4	7
Pondicherry	10.0	22.0	23.7	18.6	3

Source: NITI Aayog, 2018; Hunger index scores and Ranks are computed by authors.

The states are ranked based on their Hunger Index scores and portrayed in Table 2. Out of all Indian states and Union Territories, Kerala topped the rank by having a less severity HI score (15.3) followed by Goa (17.3), Pondicherry (18.6), Nagaland (19.1) and Sikkim (19.9). These states are grouped under "moderate" list. Bihar is the worst performer based on the HI score (43.4) followed by Uttar Pradesh (42.9), Jharkhand (40.7) and Rajasthan (38.9). These states are under alarming category.

Based on Hunger Index scores the states were classified into five groups viz. low hunger (≤ 9.9), moderately hunger (10 – 19.9), Serious hunger (20 – 34.9), alarming (35 – 49.9) and extremely alarming (>50) hunger. From the present study, it was clear that no states fall under either low hunger or extremely alarming hunger category. Their index scores fall only in three categories viz. "moderate hunger", "serious hunger" and "alarming hunger". Tabulation of states/UTs as per the index severity scale is shown below:

Table3 States/UTs based on their Hunger Severity Scale

Moderate Hunger (10 – 19.9)	**Serious Hunger** (20 – 34.9)	**Alarming Hunger** (35 – 49.9)
Goa	Andaman & Nicobar islands	Assam
Kerala	Andhra Pradesh	Bihar
Nagaland	Arunachal Pradesh	Chhattisgarh
Pondicherry	Chandigarh	Gujarat
Sikkim	Delhi	Jharkhand
	Haryana	Madhya Pradesh
	Himachal Pradesh	Odisha
	Jammu & Kashmir	Rajasthan
	Jharkhand	Uttar Pradesh
	Karnataka	
	Maharashtra	
	Manipur	
	Manipur	
	Meghalaya	
	Mizoram	
	Punjab	
	Tamil Nadu	
	Tripura, Uttarakhand	
	West Bengal	

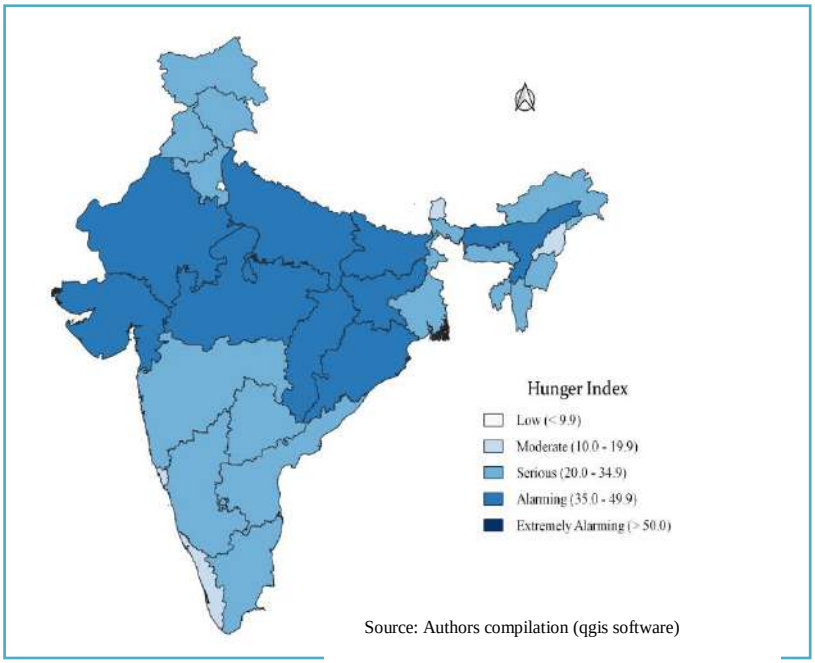

Figure 1 India State Hunger Index, 2018 - Severity Scale

Relationship between India Hunger Index and Socio Economic Indicators

Correlation analysis is done in order to find the relationship between Hunger Index and socio economic indicators. The economic indicators include state wise growth rate (2018) and poverty rate (2018) in India. The result of the analysis is given below.

Table4: Relationship between Hunger Index and Socio Economic Indicators

	Hunger Index	Poverty rate	Growth rate
Hunger Index	1	0.6834	-0.4657
Poverty rate	**0.6834****	1	-0.321
Growth rate	**-0.4657****	-0.321	1

It could be revealed from Table 4 that, poverty rate and growth rate is highly correlated with Hunger Index. There exists a positive relationship between HI and poverty rate which indicates that hunger increases with increase in poverty rate. On the contrary, there exists a negative relationship between HI and growth rate which clearly infers us that country's growth decreases with increase in hunger.

CONCLUSION

The India State Hunger Index 2018 findings highlighted the continued overall severity of the hunger situation in India, while revealing the variability in hunger across states within India. It is indeed alarming that not a single state in India is low in terms of their hunger index scores; most states have "serious" hunger problem, and others have moderate and alarming hunger.

The results of correlation analysis revealed that, there exists a positive relationship between hunger and poverty. Also, it revealed that, there exists a negative relationship in terms of hunger and growth rate.

The experiences of states whose rankings on the Hunger Index worsened on the ISHI 2018 scores inspite of consistent positive economic growth is indicative of the need to invest solidly in direct nutritionand poverty alleviation interventions even in the face of continued economic growth. The design andimplementation of policies and programs to improve all three underlying dimensions of the India State Hunger Index (ISHI) willneed to be strengthened and supported to ensure that hunger is reduced rapidly over time.

Whileprogresses are being made on the public health front to ensure sustained reductions in child mortality,enhancements in child nutrition are not satisfactory in India. This is mainly because nutrition programsin India are not effectively delivering evidence-based interventions at scale to those vulnerable agegroups which need to be reached to ensure rapid reductions in undernutrition.In conclusion, for Indian states to progress along the ISHI, and to ensure that ISHI scores for Indian statesare more closely aligned with GHI scores of countries with similar economic growth, investmentswill be needed to strengthen agriculture, improve overall food availability and access to all populationsegments, and to improve child nutrition and mortality outcomes.

REFERENCES

Dandekar V.M.,& Rath, N. (1971). 'Poverty in India'. Indian School of Political Economy, Pune.

IIPS. (2007).'National Family Health Survey 2005-06 (NFHS-3). National Report'. International Institute of Population Sciences, Mumbai

Wiesmann D. (2004) '*An International Nutrition Index: Concept and Analyses of Food Insecurity and Undernutrition at Country Levels'.* Development Economics and Policy Series No. 39. Peter Lang, Frankfurt a. M.

Swaminathan, M. S. (2002). Food Insecurity Atlas of Urban India. Research Foundation and the World Food Programme, 212.

Growing Dairy Industry, Confused Farmer

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India is the world's largest milk producer and consumer of dairy products, producing around 160 million tonnes each year and consuming almost 100% of its own milk production. The Indian dairy sector is a little different from other dairy producing countries as emphasis is placed on both cattle and buffalo milk. Even then, dairy farming is a largely unorganized sector in India. The dairy farmers are not getting remunerative price for milk supply. In order to achieve greater profitability, quality standards and farming environment need to be improved. Also there is a poor perception of the farmers, due to lack of marketing facilities and extension services, towards commercial dairy enterprise as an alternative to other occupation.

The growth of dairy industry has to be accompanied by expansion of governmental regulations and controls relating to both marketing and production of the products. The department of Animal Husbandry, dairying and fisheries is implementing Dairy Entrepreneurship Development Scheme (DEDS) for generating self-employment opportunities in the dairy sector, covering activities such as enhancement of milk production,procurement,preservation,transportation,processing and marketing of milk by providing back ended capital subsidy for bankable projects. The scheme is being implemented by National Bank for Agriculture and Rural Development (NABARD).The National Programme for Dairy Development (NPDD) scheme was launched by the Government of India. The NPDD scheme is designed to provide technical and financial assistance for the dairy development and thereby creating any infrastructure related to the processing, production, marketing and procurement by the milk federation/unions while extending their activities by providing training facilities to the farmers. This scheme is implemented with the view to dairying activities in a scientific and holistic manner and integrates milk production so as to attain higher levels of milk production and its productivity, ultimately to meet the increasing demand for milk in the country. Union Minister of Agriculture and Farmers' Welfare has inaugurated the Dairy Processing & Infrastructure Development Fund (DIDF). It has vast opportunities exist today for dairy entrepreneurs and in order to concretize these opportunities and help double the income of dairy farmers.

Dairying and its other activities have become a very important secondary source of income for millions of rural families and have the most important role in providing income-generating opportunities and employment opportunities particularly for marginal and women farmers as most of the milk that is produced by animals reared by small, marginal farmers and landless labours. A vigorous education and training programmes on good dairy practices could result in the production of safe dairy products. In this regard, education and training of all the farmers is essential so that they understand what they are doing and develop a sense of ownership. However developing and implementing such programs in the dairy sector requires a strong commitment from the management, which at times, is a stumbling block.

Harvest quality fodder from berseem and ryegrass in mixed crops

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Modern ways of agriculture like mechanization, monocultures, improved crop varieties, and heavy use of agrochemicals for fertilization and pest management, led to a simplification of the components of agricultural systems and a loss of biodiversity. Biodiversity can be restored by crop rotation, intercropping, use of cover crops, and agro-forestry. Intercropping terms can be explained as the "practice of growing more than one crop at the same place and at the same time." It is mainly of four types: relay intercropping, strip intercropping, row intercropping, and mixed intercropping.Intercropping systems help farmers to exploit the principle of diversity because they are helpful to avoid reliance on a single crop and result in a variety of products of a different nature such as forages, oil and pulses. Another key advantage associated with intercropping is its potential to increase the land productivity per unit area and the efficient utilization of farm resources. Cereals intercropping with legumes result in increased resource capture by component crops and improve soil microbial activity along with better efficiency of resource conversion which triggers higher biomass production. Soil fertility is also improved when legumes are intercropped with cereal forages.Mixing of forage crops (cereals and legumes) clearly have many advantages and are superior to their monocultures in providing greater yield and quality. Legume- cereal intercropping has also given more economic returns than mono-cropping which is utmost in forage production. Integration of legumes and cereals has enhanced the availability of fodder and quality of available fodder for livestock population. But in order to get all the advantages of intercropping of forage crops, the component crops selected for intercropping should satisfy the following conditions:

- They should not compete with each other for growth resources.
- They should complement each other at different stages of growth.
- They should have high protein content and able to produce maximum yield with same harvest time.
- They should be able utilize the resources efficiently and have a sustainable effect on soil.

Berseem and ryegrass both are important*Rabi* fodder crops that are grown in different parts of the world in pure as well as mixed form.Berseem (*TrifoliumAlexandrium* L.) is a leguminous fodder crop and originated from Egypt and introduced in India in the early 19th century.Berseem is also regarded as "the king of fodder crops "which may be due to its yield potential. It is also quite nutritive and succulent than other fodder crops after lucerne. Its forage is superior in protein content and minerals than grasses. It improves the soil characteristics like physical, chemical and biological properties. It gives up to 5-6 cuts under Indian conditions. Ryegrass (*Loliumperrene*. L) is also winter forage which belongs to the *Poaceae*family. It may be grown as annual as well as perennial. It can resist to very low temperature than other winter forages and also adapted to a wide variety of soils. Forage of ryegrass will have high protein content (up to 14% under the Indian conditions and 18% in western countries) and dry matter content. Its high nutritive value and palatability that's why it is more preferred by livestock. It also enhances the yield potential of livestock and increases the fat content of milk obtained fromlivestock. Evidence is there all over the world supporting these facts actively. But ryegrass being a grass crop, is not advantageous to grow in pure stand year after year as it had shown its negative effect on livestock health and soil properties. Therefore, to counter these problems, ryegrass has been grown intercropped with berseem. Mixing berseem and ryegrass has a lot advantages and its forage quality is outstanding.

View of berseem and ryegrass mixed cropping

CHARACTERISTICS OF BERSEEM-RYEGRASS COMBINATION

Berseem and ryegrass have been used as a combination for fodder production in different parts of the world. They have been sown together in different seed ratios for improving production and quality of fodder. This is because of the fact that fodder production is not sufficient enough to feed the livestock population of the world. In temperate countries like United states where winter are longer than summers and temperature may fall down below 0 ^{0}C which also reduce the growth of other winter forage crops.In these conditions, berseem and ryegrass has given a better alternative as

they have the ability to tolerate lower temperatures without affecting their growth. Berseem and ryegrass when grown together in mixed cropping system have shown impact on their growth, production and fodder quality. Different studies on this combination revealed thatwhen mixed together with seed ratio in 3:1 and 1:1 (berseem: ryegrass) had given high green forage yield and dry forage yield. It has been also stated that this combination had given higher quality forage and more crude proteinthan the pure crop of ryegrass. Berseem and ryegrass combinationhas also shown an impact on the uptake of nutrients from the soil and enhancing their growth by absorbing major nutrients. Biological nitrogen fixation has been increased in case of berseem - ryegrass mixed cropping as berseem being a legume crop has the ability to provide nitrogen to the combination itself. This may be reason that ryegrass plant height has also been influenced in berseem ryegrass intercropping. Berseem and ryegrass integration has also given higher green fodder and dry fodder than their sole crops. Since berseem is a legume crop and also will help in improving of different properties of soil. Berseem mixed with ryegrass can be grown by applying different sources of nutrients as well. This combination has shown better growth under the application of inorganic, organic and bio-fertilizers but will give better results under the application of combined form of nutrients.Organic manures like poultry manure, FYM (Farm yard manure) and vermicompost can be applied as nutrient source which will have impact on growth and yield and will also help to increase the biodiversity of soil. Forage crops like berseem and ryegrass have the ability of carbon sequestration thus improving the soil fertility.

Fodder quality can be defined in terms of utilization of feed by animals which can be determined by palatability, intake, digestibility and anti-quality factors. Fodder quality of berseem-ryegrass combination has been superior to their sole crops. The palatability of fodder obtained from this mixture has been higher which will have an effect on intake of feed by animals. The digestibility of fodder obtained from this mixture was also better than other mixture because the crude fibre content is lower which may be due to the reason of combined effect of both these crop. Protein content of this mixture has found to be higher which will help in maintenance of body of livestock. It has been found that grazing intensity of livestock had increased in the area under berseem ryegrass intercropping system.

PROSPECTS OF BERSEEM AND RYEGRASS INTERCROPPING UNDER INDIAN CONDITIONS

As discussed above, berseem and ryegrass when integrated with each other has proved to be quite beneficial in terms of quality and quantity. Furthermore, intercropping system has also given higher economic returns than the sole crops so it will also give benefits to the farmers in the same way. In the current situation, fodder production has been reduced to 4.5% of the total cultivated area which causes a deficiency in availability of fodder for livestock. Also, this deficiency causes lean period during June- July and November-December which can be ended by using berseem – ryegrass combination. Most of the farmers in India are small and marginal ones who will get the advantages like profit maximization, risk minimization, weed smothering

effect, disease and pests resistance.Therefore, it may be concluded that berseem ryegrass combination can be seen as an alternative for higher fodder production and restoring balance in the soil ecology under Indian conditions.

Package and practices of cultivation of berseem and ryegrass(sole crops)

	Berseem	**Ryegrass**
Seed rate (kg/ha)	25	5-8
Nutrient mgt. (kg/ha)	25:60 (N:P:)	80:40:(N:P:) and 60kg/ha after each cut
Variety	Mescavi,BL-44,BL-42, BL-9, BL-11	Makkhan Variety, OS-9, Punjab ryegrass No.1
Number of Irrigations	6-8	6-8
Number of Cuts	5-6	5-6
Harvest	1st- 55-60daysand then each cut 25 days	1st- 50-60daysand then each cut 25 days
Green Yield (quintal/ha)	800-900	530

Role of Various Beneficial Schemes in Vogue to Promote Agricultural Marketing

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The grit and toil of farmers, consistent endeavour of policy makers and dedication of agricultural scientists have together contributed in transforming Indian agriculture from an importer of food grain to a major exporter of food grains now. However, post-harvest marketing infrastructure and the marketing systems have not been able to keep pace with the growing production and marketable surplus. As for any sector to be successful needs a robust marketing system in place the same too applies to agriculture. Thus it has brought to the fore, the need for providing farmers with access to competitive markets with adequate infrastructure including cold chain logistics and IT enabled support system so that farmer remains informed about all these on real time basis so that it will enable them to realise better prices on the one hand and providing nutritious food to consumers at stable and affordable prices. With this above objective in view, the Government of India approved the proposal of Department of Agriculture & Cooperation for continuation and integration of on-going Central Sector Schemes as Integrated Scheme for Agricultural Marketing (ISAM) on 13th November, 2013.

THE ISAM HAS BEEN DIVIDEDIN TO THE FOLLOWING FIVE SUB SCHEMES:

1) **Agricultural Marketing Infrastructure (AMI):**the existing schemes of Grameen Bhandaran Yojana (GBY) and Development/Strengthening of Agricultural Marketing Infrastructure, Grading and Standardization (AMIGS) will be merged as AMI
2) **Marketing Research and Information Network (MRIN)**
3) **Strengthening of Ag-mark Grading Facilities (SAGF)**
4) **Agribusiness Development (ABD) through Venture Capital Assistance (VCA) and Project Development Facility (PDF)**
5) **Choudhary Charan Singh National Institute of Agriculture Marketing (NIAM)**

The objective and the operational plan of all the sub schemes needs to be understood so that a proper integration of all these schemes will create a better marketing support system that will result in better revenue flow for the farmers and prevent them from a state of panic and distress sells.

Agricultural Marketing Infrastructure (AMI):

Directorate of Marketing & Inspection (DMI) an attached office of the Department of Agriculture, Cooperation & Farmers Welfare is implementing Agricultural Marketing Infrastructure (AMI), a sub-scheme of Integrated Scheme for Agricultural Marketing (ISAM). The scheme is effective from 01.04.2014 and was created after subsume of erstwhile Grameen Bhandaran Yojana being implemented since 01.04.2001) and Scheme for Development/Strengthening of Agricultural Marketing Infrastructure, Grading & Standardization (being implemented since 20.10.2004). The objectives of the scheme are out lined below.

(i) To develop Agricultural Marketing Infrastructure including storage infrastructure for effectively managing marketable surplus of agriculture, horticulture and allied sectors like dairy, poultry, fishery, livestock and minor forest produce.

(ii) To facilitate creation of scientific storage capacity for storing farm produce, processed farm produce and agricultural inputs etc. which reduce the post-harvest and handling losses,

(iii) To give infrastructure facilities for grading, standardization and quality certification of agricultural produce and to promote pledge financing and marketing credit, negotiable warehousing receipt system. It is a credit linked, capital investment back end subsidy Central Sector Sub-scheme.

Marketing Research and Information Network (MRIN):

Information regarding marketis essential for farmers while planning production and marketing of their produce and equally needed by other market participants in arriving at optimal marketing decisions. Implementation of Marketing Research and Information Network, sub Scheme of Integrated Scheme for Agricultural Marketing (ISAM) through State Marketing Boards/APMCs spread across the States/UTs with the technical assistance from NIC/IT Division of DAC & FW. The objectives of the MRIN scheme are as under.

a) Facilitate for timely and quality data reporting on the Agmarknet portal from APMC/Markets of the country

b) Monitoring and dissemination of data in respect of Mandi/market prices and arrivals reported by the APMCs/Markets on the Agmarknet Portal

c) Release of Financial Incentives to the Data Reporting/Monitoring Officials.

d) Development of National Agricultural Market Atlas (NAMA) portal in the GIS platform.

e) Market Atlas (NAMA) would provide information in respect of the commodity with regard to major areas of market charges, market arrival, movement and storage, etc.

f) Updating of market profiles by APMCs to make available functional information on various mandis in the public domain.

g) Undertaking marketing research studies/other useful studies and training programmes.

h) Conducting farmer's awareness programmes at market level and promoting Marketing Extension activities under Marketing Research and Information Network (MRIN) sub-scheme of ISAM, etc.

Research and Information Network (MRIN) sub-scheme of ISAM, etc.

Activities of Extension Division under MRIN:

i. Publicity and Extension work pertaining to Agmark Certification and Agricultural Marketing Schemes implemented by the Directorate.
ii. Organizing Agmark Exhibition every year.
iii. Participation in the India International /National/State level Trade fairs and exhibitions by various Govt. Departments.
iv. Organization of National Consumer Day/ World Consumer Day through Regional Offices.
v. Participation in the public awareness programme organized by State Agricultural Marketing Boards / State Agricultural Universities, etc.

Activities of Statistical Section of MRIN

1. Maintenance of Statistical Data base of Directorate.
2. Preparation of Wholesale and Rural Primary Markets, Regulated Markets Annual report.
3. Publication of Annual Statistical Bulletin of the Directorate.

Strengthening of Ag-mark Grading Facilities (SAGF):

Grade Standards provide a common language for trade among growers, traders, processors etc. They provide a basis for incentive payment rewarding better quality. Farmers get prices commensurate with the quality produced by them. Grade standards help in electronic trading and issue of Negotiable Warehouse Receipt. The Agricultural Produce (Grading and Marking) Act, 1937 provides for framing of grade standards and their certification. SAGF sub scheme of the ISAM Scheme is an ongoing plan scheme to support grading and marking of agricultural produce, which involves framing of grade standards and certification of agricultural commodities included in the Schedule of the Agricultural Produce (Grading and Marking) Act, 1937. SAGF sub scheme aims to help DMI implement the Act including meeting the expenditure for the purchase of equipment, chemicals, glassware and apparatus, Annual Maintenance Contract (AMC) of the equipment as well as renovation and repair works in the Agmark laboratories/ Regional and Sub-offices of DMI. With this support, 11 Regional Agmark Laboratories and Central Agmark Laboratory, Nagpur are carrying out analysis of research samples and check samples for developing and promoting grading & standardization of agricultural commodities under Agmark.

OBJECTIVES

The main objectives of the sub scheme are:

i. To help farmers get better and remunerative prices by grading of their produce.
ii. To frame grade standards of agricultural commodities as per the provisions in Agricultural Produce (Grading and Marking) Act 1937
iii. To facilitate implementation of AGMARK certification programme for commodities for which grade standards are notified for domestic trade and for exports.

iv. To analyse research samples for creating analytical data base for the framing/ revision of grade standards of agricultural commodities.

IMPLEMENTING AGENCY

Directorate of Marketing & Inspection (DMI) in the Department of Agriculture & Cooperation, Ministry of Agriculture, is the Nodal authority for certification of agricultural commodities including horticulture commodities under AGMARK.

Agribusiness Development (ABD) through Venture Capital Assistance (VCA) and Project Development Facility (PDF):

The farming is considered as the single largest private sector economic activity in the country. The growth potential in this key sector is immense in view of the changes taking place in food consumption and there is growing demand for high value processed products. Successes in such endeavors will require innovations and partnerships. Private agribusiness provide first point market for the farm sector and growth depends principally on private initiatives. The result of small and medium enterprises plays a significant rolein agribusiness activity. Such enterprises are necessarily widespread in location to capture opportunities that arise all along the farm to table supply chain. Access to information and access to credit are the two key constraints that impede development of new agribusiness projects. Agribusiness entrepreneurs are generally first generation who have business skills but their financial resources are limited for setting up units at the farm gate with backward linkages. In order to facilitate agribusiness development in the country SFAC venture capital sub scheme will:

a. Assist agri-preneurs to make investments in setting up agribusiness projects through financial participation, and

b. Provide financial support for preparation of bankable Detailed Project Reports (DPRs) through Project Development Facility (PDF).

OBJECTIVES:

The main objectives of the sub scheme are:

a. To facilitate setting up of agribusiness ventures in close association with all Financial Institutions notified by the Reserve Bank of India where the ownership of the Central/State Government is more than 50% such as Nationalized banks, SBI & its subsidiaries, IDBI, SIDBI, NABARD, NCDC, NEDFi, Exim Bank, RRBs & State Financial Corporations.

b. To catalyze private investment in setting up of agribusiness projects and thereby providing assured market to producers for increasing rural income & employment.

c. To strengthen backward linkages of agribusiness projects with producers.

d. To assist farmers, producer groups, and agriculture graduates to increase their participation in value chain through Project Development Facility.

e. To arrange training and visits, etc. of agri-preneurs in setting up identified agribusiness projects.

f. To augment and strengthen existing set up of State and Central SFAC.

Choudhary Charan Singh National Institute of Agriculture Marketing (NIAM):

The agriculture marketing sector is today witnessing many challenges in the form of trade liberalisation, globalisation, diversification towards high value crops, changing market demands, etc., and therefore needs to become more responsive. Guiding the direction of change in agricultural marketing has become even more challenging. The main endeavour of the subscheme, through capacity building, conducting training, consulting solutions, education and policy advocacy, will be to escalate the agricultural marketing system in the country to a level where it can go hand in hand with the production and market sentiments.

OBJECTIVES OF THE SUBSCHEME

1. To undertake and promote the study of applied and operational research in problem areas of agricultural marketing and to act as a national level nodal point for coordination of different research studies and dissemination of technologies relevant to agricultural marketing in the country.
2.To impart training to various levels of personnel of organizations involved in agricultural marketing activities such as State Agricultural Marketing Boards (SAMB), Co-operative Marketing Societies, Commodity Boards, State Development Departments like Agriculture, Horticulture, Animal Husbandry, Fisheries, Forestry, Sericulture, State Agricultural Universities, Input Agencies and Progressive Farmers, Entrepreneurs, etc. To help them develop bankable projects for creation of market infrastructure and integrated value chains.
3. To conduct research on long-term projects, policy formulations; prepare status paper on leading issues; case studies in specific marketing problems, processing industries, export management, etc. which have a direct bearing on the national economy.
4. To offer consultancy services to State and Central Departments, public-sector undertakings, co-operatives, etc. in the formulation of projects and prepare Master Plans for States, Export Institutions, Traders and Farmers.
5. To develop promising human resources by providing long-term structured courses in agricultural marketing through Diploma/Degree courses.
6. To help State Government to generate self-employment for educated youth by exploiting local potential resources.
7. To facilitate Government to formulate policies on emerging issues in agricultural marketing.
8. To cover a wide information network in the country in agricultural marketing to evolve efficient, innovative and competitive marketing processes.
9. To develop as a 'Centre of Excellence' in the field of agricultural marketing by establishing adequate liaison with international organizations.
Looking at all the schemes and its objectives it is clear that govt has got an exhaustive plan to support and improve the agricultural produce marketing in India. However the major impediments remain in the execution of these schemes for which the following points make sense to ensure peace mind for the farmers where he may not have to spend sleepless nights after putting in his hard work, his resources to cultivation for

which he very deservingly gets the reward without being forced to go for a distress sells.

A. Massive awareness in regional language with best possible penetration to reach out maximum farmers.

B. Hand holding the farmers to make them understand the intricacies and help in getting all the benefits.

C. Immediate online attention to grievances of farmers if any with mechanism to address it.

D. Time bound disbursement of subsidy as per eligibility without making the farmer run from pillar to post.

E. Feedback mechanism to understand and improve the schemes as and when informed and highlighted

F. Studying and bench marking better practices to bring in more efficiency and transparency.

CONCLUSION

If it is taken care of with all sincerity then the farmer community will have all the reasons to smile and stay motivated to do agriculture and will also attract young Agriprenuers which have looked down upon as a sector that is not paying and loaded with hassles of all kinds to stay away from. All hopes prevail now for a better tomorrow for agri-sector and the right marketing of the produce to bring back its lost glory.

REFERENCES

http://agricoop.nic.in/sites/default/files/finalopguidelines_0.pdf

https://www.nabard.org/auth/writereaddata/tender/1412180913Cir_283_E%20.pdf

Ul-Rehman, Shakeel, Selvaraj, M Syed, Ibrahim M. Indian Agricultural Marketing- A Review.

A Vadivelu, B R Kiran. Problems and Prospects of Agricultural Marketing in India: An Overview (2013). Indian Journal of Agricultural and Food Science.

Boron in Crucifers: Importance, Role and Management

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ABSTRACT

Crucifers are the most popular group of vegetables. These crops often show the deficiency symptoms of boron (B) as browning of curd results in loss of quality and yield. Such disorders render curds unfit, for human consumption and reduce the curd yield considerably. Crucifers like cauliflower, broccoli, cabbage responds positive to macro nutrients viz., nitrogen, phosphorus and potassium. However, micro-nutrient like boronis highly essential for its proper growth and yield. Due to boron deficiency, water soaked areas appear on the stem and head surface, gradually the stem becomes hollow and curd turns brown. Thus, its management through foliar application has been very spectacular as they play important role in flowering and fruiting, pollen germination, cell division and metabolism of carbohydrates.

Keywords: Boron, crucifers, function, deficiency, management

FUNCTIONSOF B IN PLANTS:

There is an equal importance of micronutrients even though required in lesser amounts when compared to macronutrients. Boron in plants increases from lower parts to upper parts and it is relatively immobile in plants. It plays significant role in pollen formation and quality of flowers and fruits due to its higher content in stigmas, anthers and ovaries compared to stems of plants. It is required in the structure of cell wall of plants (O'Neil et al. 2004) and this function shows the role of boron in cross-linking of cell wall proteins. It is important in the development of reproductive tissues and its deficiency causes reduction in grain set or poor quality of seeds. Its deficiency forces prior synthesis of ethylene which leads to poor fruit quality (Prasad et al. 2014).

Importance of B in Crucifers:

Out of all the micronutrients available B is a critical and most essential micronutrient and its deficiency is also wider. In plants, for metabolism of sugars and for development of meristem B is necessary. The average B content in most of the vegetables lies between 20 and 100 ppm or mg/kg. In crucifers particularly in broccoli, celery, cauliflower boron is important. Boron deficiency leads to reductionin number of

flowers, breaking of midrib, brittle leaves and stems, leaf chlorosis, necrosis, brown spots and cavities on fruits.There are evidences for the role of micronutrients involvement in the growth and yield of plants. Particularly, their role is specific to cruciferous vegetables as it play a major role in finishing of life cycle of these crops. For example, zinc has a role in synthesis of protein by activating enzymes and directly regulates the enzymes in plants. Whereas, boron involves in translocation of carbohydrates, synthesis of RNA and cell wall development by regulating metabolism (Moklikar et al. 2018).

Factors influence B deficiency:

Intense leached soils, or soils formed from alluvial deposits and calcareous showed the deficiency of B. Many of the soil factors and conditions cause deficiency of B in soils. Factors influence deficiency of B viz., sandy texture or coarse, high pH, low soil organic matter, drought, liming, intensive cultivation and more uptake of nutrients than application and also the use of fertilizers which are poor in micronutrients are considered to be the major factors associated (Niaz et al. 2007). B shows deficiency during high rainfall as it is highly soluble in water. Specifically, in sandy textured soils with pH of more than 6.2, its deficiency is noticed during high level of moisture or at rapid growth phases. The different micronutrients (Iron, Copper, Manganese, Boron, Chlorine, Molybdenum and Zinc), but Boron is crucial in these crops due to their availability depends upon the pH of the soil, mobility in plants and soil (Chaudhary et al. 2017). Thus, production of crucifers is not up to the mark because of poor soil conditions and uneven fertilization.

Deficiency Symptoms of B:

Most common and widespread micronutrient problem is the deficiency of B. These symptoms differs from species to species but usually found in growing points or flower and fruit parts of the plant. It is seen as stunted or abnormal elongation of apical meristems (Benton, 2003).Various usual symptoms like, formation of rosettes, growth of auxillary buds, chlorosis and death of the growing ends, bushy growth, multiple branching and cracking of stems (Anonymous, 2003). Symptoms on roots includes thick roots, excessive branching, twisted roots, fail to develop edible portions or affected by the presence of dark coloured corky areas, cuttings fail to take root, flower drop, fruits and seed may also be affected by developing of brown sunken areas on them (Saleem et al. 2011).

Other symptoms are leaves with yellowish or reddish cast and cruciferous crops like cabbage, cauliflower develop corky and cracked stems, petioles and midribs. Hollow stems are reported in cabbage, cauliflower and broccoli and sometimes they are discoloured. The heads of cabbage may be small and yellow, cauliflower curds become brown and leaves may roll and curl. Among all the crucifers the most sensitive to boron deficiency is cabbage.Crucifers with boron deficiency is noticed in cauliflower, turnip and rutabaga as they are very sensitive which causes brown heart, mottled heart, raan, water core etc. Its deficiency prone to poor development of cell walls that easily

collapse. In cauliflower the first visible symptom appears on the head as a firm, tan-coloured or water-soaked spot. Internal stem tissues may also have affected with water soaked spots. Curd is discoloured and dark totally but it is firm (Cutcliffe and Gupta, 1987). The outer stem tissues near the base of the midrib of petioles near to the head may crack, become corky and brown. In stem tissues cavities formed also turn brown, and the tips of newly formed leaves become light brown. A bitter taste is formed in the curd. In turnip, rutabaga the deficiency of boron is in edible root and first appears as areas of brown discoloration that are spread, grouped or arranged in a concentric form. The root central portion is discoloured severely. Only bottom 2/3rd of the root symptoms are present but, in severe cases it may extend to crown, and cavities may form (Gupta, 1979). The affected tissues develop bitter flavour and become fibrous. Further, these are invaded by soft rotting microbes. Mild affected roots do not show superficial symptoms. In intense phases, roots are decreased in size and external root tissues may become rough, corky or leathery. Leaves may develop a purplish tinge on underside and leaf margins become chlorotic in severe cases.

Managementand Precautions for B deficiency:

- ✓ Supply boron before the deficiency symptoms are seen.
- ✓ Timely irrigation helps in prevention of B deficiency by maintaining a uniform soil moisture.
- ✓ Foliar spray of B can be done before head formation in crucifers.
- ✓ A boronated fertilizers like Borax and Boric Acidcan be recommended.
- ✓ Practise foliar application of boron in high pH soils.
- ✓ Apply 1.5 kg/acre of boron to broccoli, brussels sprouts, cabbage, collards and cauliflower and kale with mixed fertilizers before planting.
- ✓ In cole crops if soil application is not done they may be foliar sprayed.
- ✓ Spraying concentration: 90-100 gm/acre of actual boron (500 to 750 gm of solubor 20.5%) in sufficient water (30 or more gallons).

Table-Composition of different B fertilizers and commercialised products

Boron fertilizers		
Fertilizer	**Chemical compound**	**Details**
Borax	Sodium tetraboratedecahydrate [$Na_2B_4O_{10}H_2O$]	Contains 11 % B Water soluble white salt Applied as a soil dressing or foliar application
Boric acid	H_3BO_3	Contains 18 % B A white crystalline powder Applied as a foliar nutrient
Market Products		
Product	**Quantity**	**Price**
m6 Foliar spray	1 Kg	500
Solubor	250 gms	135
Biosar Boron 20	250 gms	150

Yield and Productivity as influenced by the application of B

Broccoli: The major disorder in broccoli production and cause for its yield reduction is hollow stem which is due to the deficiency of boron (Shelp et al. 1992). Various studies reported that application of boron increased yield of broccoli. Hussain et al. (2012) found that application of boron upto 1.0 kg/ha increased yield of broccoli. This rate of application showed reduction of hollow stem disorder.

Cauliflower: In soils of Himachal Pradesh, cauliflower reacted positive to the application of boron @ 1 mg/kg in Junga soil and @ 2 mg/kg in Bajaura soil (Chander et al. 2010). Among different treatments, borax @ 20 kg/ha + sodium molybdate @ 2 kg/ha as soil application along with RDF of NPK @ 120-60-60 kg/ha resulted in maximum width of curd, average weight of curd and yield of curd, whereas, foliar application of boron @ 100 ppm + molybdenum @ 50 ppm along with RDF of NPK @ 120-60-60 kg/ha recorded maximum growth and yield (Kumar et al. 2010). Application of boron @ 1.5 kg/ha recorded maximum plant height, curd diameter and yield in the applied plots (Singh et al. 2011).Kumar et al. (2012) conducted studies and reported that granubor-II as a boron source improved not only quality but also the productivity of cauliflower and the boron @ 1.5 kg/ha improved quality and yield compare to other rates (0.5 & 1.5 kg/ha).

CONCLUSION

Boron deficiency is often seen in crucifers. Its deficiency causes several anatomical, physiological and biological variations. Its deficiency resulting symptoms in crucifers,like smaller size heads, irregular shape,hollow stem and browning of heads and bitter tastes affecting the market demand of the produce. Its management through proper methodologies can help solving such greater amount of losses. Application of B at right time, at right rate and through right methodologies will increase the yields of the crop as it is needed higher in crucifers than any other crop species.

REFERENCES

Anonymous, (2003). Boron Fact Sheet. Incitec Pivot Limited 70 Southbank Bvd, Melbourne 3006. www.incitecpivot.com.au.

Benton, J.J. (2003). Agronomic handbook; management of crops, soils and their fertility. CRC press LLC. USA.

Chander, G., Verma, T.S. and Sharma, S. (2010). Nutrient content of cauliflower (Brassica oleracea L. var. botrytis) as influenced by boron and farmyard manure in North West Himalayan Alfisols. *J. Ind. Soc. Soil Sci*. 58(2): 248-251.

Chaudhari, V.J., Patel, N.K Tandel, B.M. and ChaudhariVibhuti. (2017).Effect of foliar spray of micronutrients on growthand yield of cauliflower (*Brassica oleracea*L. var.botrytis).*International Journal of Chemical Studies*, 5(6): 1133-1135.

Cutcliffe, J.A., and U.C. Gupta. (1987). Effects of foliar sprays of boron applied at different stages of growth on incidence of brown-heart in rutabagas. *Can. J. Soil Sci*. 67:705-708.

Gupta, U.C. 1979. Boron nutrition of crops. *Adv. Agron.* 31:273-303.

Hussain, M.J., Karim, A.J.M.S., Solaiman, A.R.M. and Haque, M.M. (2012). Effect of nitrogen and boron on the yield and hollow stem disorder of broccoli (*Brassicaoleracea* var. Italica). *The Agriculturists*, 10(2): 3645.

Kumar S.P., Bhagawati, R., Choudhary, V.K., Preema Devi and Ronya, T. (2010). Effect of boron and molybdenum on growth, yield and quality of cauliflower in mid altitude condition of Arunachal Pradesh. *Vegetable science*, 37 (2): 190-193.

Kumar, A., Parmar, D.K. and Suri, V.K. (2012). Effect of boron fertilizers and organic manure on autumn cauliflower in western Himalayas. *Annals of Horticulture*, 5(1): 17-24.

Moklikar, M.S., Waskar, D.P., Maind, M.M. and Bahiram, V.K. (2018)Studies on Effect of Micro Nutrients on Growth and Yield of Cauli-Flower(*Brassica oleracea*var. botrytis) cv. Sungro-Anandi. *Int. J. Curr. Microbiol. App. Sci*,6: 2351-2358.

Niaz, A., Ranjha, A., Rahmatullah, M., Hannan, A. and Waqas, M. (2007). Boron status of soils as affected by different soil characteristics-pH, CaCO3, organic matter and clay contents. *PakistanJournal of Agricultural Sciences*, 44: 428-435.

O'Neil, M.A., Ishi, T., Albersheim, P. and Darvill, A.G. (2004). Rhamnogalacturoran II: Structure and functions of a borate cross-linked cell wall pectic saccharide*. Annual Review of Plant Biology*,55: 109-39.

Prasad, R., Kumar, D.,Shivay, Y.S. and Rana, D.S. (2014).Boron in Indian agriculture – A review *Indian Journal of Agronomy,* 59(4): 511-517.

Saleem, M., Khanif, Y.M., FauziahIshak, Samsuri A.W. and Hafeez, B. (2011). Importance of Boron for Agriculture Productivity: A Review- *International Research Journal of Agricultural Science and Soil Science*, 1(8): 293-300.

Shelp, B.J., Penner, R. and Zhu, Z. (1992). Broccoli (*Brassicaoleracea* var. Italica) cultivar response to boron deficiency. *Canadian J. Pl. Sci*. 72: 883-888.

Singh, K.P., Singh, V.K., Kamalkant, and Roy, R.K. (2011). Effect of different levels of boron and its methods of application on growth and yield of cauliflower (*Brassicaoleracea* var. botrytis L.). *Veg. Sci*. 38(1): 76-78.

Hybrid cotton: A Hidden Truth behind the Breakdown of Bt-cotton Resistance against Bollworm

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ABSTRACT

India introduced Bt cotton for cultivation in 2002 to reduce the yield losses caused by bollworm and minimize insecticide use. Bt cotton was planted on 11.7 million ha area in the country, which around 93.6% of the total area under the cotton crop in 2018-2019. Improved hybrids having Bt gene from *Bacillus thuringiensis* remarkably increase the cotton production across the country. Initially, the researcher developed Bt cotton through transferring of the *Cry1Ac* gene from *Bacillus thuringiensis* with commercial trademark Bollgard-I. Lateron due to increased susceptibility against bollworm scientists stacked another Bt gene *Cry1Ab* in cotton hybrids to provide unbreakable resistance against bollworm with a trade name Bollgard-II. Now, it is observed that bollgard-II also got susceptible to bollworm attacks in India. Interestingly, it was found that only Indian Bt cotton hybrids were more prone to acquired susceptibility to bollworm attacks as compared to varieties available in other cotton-growing countries. The reason behind acquired resistance by bollworm insect against Bt Cry protein could be the use of Bt technology in long-duration cotton hybrids, improper and ignorance of cultivation practices followed in Indian cotton cultivation.

Key words: Cry gene, Bollworm, Bt-technology, Bt-cotton, Resistance

INTRODUCTION

Bt cotton is a genetically modified cotton crop contains the *Cry* genes from *Bacillus thuringiensis* that provide resistance to cotton plants against bollworm attacks. The presence of *Cry* genes in the cotton plant synthesizes an insecticidal crystal protein, which kills bollworm insects upon feeding. In India, the researcher has transferred the *Cry1Ac* gene from *Bacillus thuringiensis* in Bt cotton hybrid and released for commercial cultivation with trademark Bollgard-I. The adaption of Bt cotton hybrids for the cultivation leads to a remarkable rise in cotton production across the country. Within 18 years (2002 to 2019), India tripled cotton production from 13 million bales to 35

million bales in 2019 with the development of superior cotton hybrids and use of Bt technology to reduce the yield loss caused by bollworm insect. It was found that within the few years of cultivation, Bollgard-I got susceptible to bollworm attack due to acquired resistance against the Bt protein. To provide unbreakable resistance to the Bt cotton hybrids, researchers staked one more Bt gene *Cry1Ab* in the existing cotton hybris and release in the market with trade name Bollgard-II. Bollgard-II consists of two Bt genes (*Cry1Ac, Cry2A*b) having dissimilar mechanisms and modes of action to provide resistance against bollworm attack. In 2014, it was observed that, besides the presence of two bollworm resistance genes, cotton hybrids were found to be susceptible to bollworm attack. The breakdown of Bt resistance against bollworm leads to huge losses up to 7,000 crores were reported in 2018. The resistance acquired by bollworm against Cry protein arises questions mark on the sustainability of Bt cotton, which covered more than 90% of cotton cultivation in India. Worldwide Bt cotton is cultivated in more than 14 countries, but only Indian hybrids with Bt genes were found to be more prone to bollworm susceptibility. China and Mexico still effectively control bollworm using Bollgard-I. The United States and Australia are moving on to Bollgard-III without facing the bollworm susceptibility problem. Now, the major question arises, why did India is the only Bt cotton cultivating country suffer from this unique disaster?

BREAKDOWN OF BT RESISTANCE AGAINST BOLLWORM ATTACK IN INDIA

In India Bt gene introduced in the cotton hybrids which were cultivated for a long duration. The agreement between Monsanto and Indian seed companies was restricted to the use of Bt technology only in cotton hybrids because hybrids are economically very attractive to seed companies owing to their "value capture mechanism". Majority of the Bt hybrids available in the Indian markets bushier and required 180-to 200-day duration to complete their life cycle. To get the maximum yield with the less cultivated area, Indian farmers planted them at low densities (11,000 to 16,000 crops/ha), whereas countries like Brazil and U.S. plant at high densities (80,000 to 100,000/ha). Many farmers took the ratoon crop of Bt cotton hybrid up to 300 days**.** The presence of host crops for a longer duration with creates a favourable selection pressure for the evolution of bollworm insect against Bt protein. The refugia scheme is essential for maintaining the susceptible bollworm population at the equilibrium. Indian farmers do not follow the refugia scheme with the fear of planting of non-Bt cotton would make entire Bt-cotton crop susceptible to bollworms. The transgenes encoding cry toxins will be present in homozygous condition in varieties, while in hybrids transgenes present in hemizygous condition. Homozygous condition of transgenes in varieties expressed higher levels of cry toxin in comparison to the hemizygous hybrids. Farmers of other countries grown short duration cotton varieties (up to 160 days) and followed standard planting practices like planting of 15 % to 20% area of refuge crop, removed or destroyed by root cutting, ploughing, or spraying herbicide for removal of cotton residues, which may act as a host for bollworm species. All these standard cultivation practices of cotton cultivation minimize the selection pressure required for build-up resistance in bollworm against Bt protein.

REFERENCES

Kathage, J. and Qaim, lM., 2012. Economic impacts and impact dynamics of Bt (Bacillus thuringiensis) cotton in India. *Proceedings of the National Academy of Sciences*, *109*(29), pp.11652-11656.

Rocha-Munive, M.G., Soberón, M., Castañeda, S., Niaves, E., Scheinvar, E., Eguiarte, L.E., Mota-Sánchez, D., Rosales-Robles, E., Nava-Camberos, U., Martínez-Carrillo, J.L. and Blanco, C.A., 2018. Evaluation of the impact of genetically modified cotton after 20 years of cultivation in Mexico. *Frontiers in bioengineering and biotechnology*, *6*, p.82.

Tabashnik, Bruce E., and Yves Carrière. "Field-evolved resistance to Bt cotton: bollworm in the US and pink bollworm in India." *Southwestern Entomologist* 35, no. 3 (2010): 417-424.

Mobile App in Sheep and Goat Farming – A Research Note

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Efficient dissemination of technological information from the research system to farmers' field and reporting of farmers' feedback to the research system is one of the critical inputs in transfer of technology. Information and Communication Technology (ICT) is one of the means, the potential of which can be exploited to strengthen the bridge between research system and farming system. ICT has the potential to help farmers in acquiring and accessing information which can be transformed to enhance agricultural and livestock production and productivity. Modern communication technologies when applied to conditions in rural areas can help improve communication, increase participation, disseminate information and share knowledge and skills.

Presently, wide range of ICT platforms are being used to access and share agriculture, veterinary and animal husbandry information and knowledge in the form of web pages that includes audio, video and text messaging. Among various ICT tools, mobile phone has emerged as one of the widely accepted and adopted instruments in most parts of the world to ease the information communication process among farming communities (Hayrol et.al.2009), Mittal and Tripathi (2009) reported the key role played by mobiles in lowering transaction costs and raising the income levels of farmers, by efficiently addressing agricultural information requirements, while Inigo et. al. (2014) and Mittal et. al. (2010) reported that mobile phones contribute greatly to agricultural and animal husbandry information dissemination.

Mobile telephony is a new phenomenon in seeking animal husbandry related information by opening up the opportunities in accessing information various aspects like breeding, management, disease control, marketing etc. However, lack of customization of these services to serve specific needs of farmers and lack of operational knowledge are some of the impediments in effectively leveraging the potential of mobile phones for livestock farmers.

Though, mobile is considered as an emerging tool in Indian dairying (Rathod and Chander 2014), still there is a need to emphasize the initiatives of public sector for information delivery through mobiles, and study the perception of multi-stakeholders viz. livestock farmers, scientists and extension personnel towards mobile use in

livestock enterprises. Now a day, the popularity of an Android Smart Phone is increasing very fast. Smart phone has become the basic need of mostly every one. An android is one of the smart phone operating system the applications of which are available freely on an Android Market. An Android user easily and freely downloads android application.

A Situation Assessment Survey of Farmers was done by the National Sample Survey Organization (NSSO) on Access to Modern Technology for farming, which indicates that only 5.1 per cent of the households access information on animal husbandry against 40.4 per cent for crop farming (NSSO, 2005). Thus, the present scenario necessitates the provision of systematic flow of information and knowledge to the livestock farmers for better decision making. Information adoption among farming community is widely acknowledged as one among the critical factors for effective agricultural decision making (Galloway and Mochire, 2005; Rao, 2006). It has been stressed that the use of Information and Communication Technology (ICT) has a great potential to boost the economy of livestock, agriculture, and rural artisans in India (Sasidhar and Sharma. 2006).

Among ICTs, mobile telephony has emerged as the smart technology of choice of the majority of the urban and even the rural masses (Ansari and Pandey, 2013). As such, mobile phones have been regarded as the widely accessed tool among the farmers for communication and also accessing agriculture-related information. India is the second largest smart phone user country in the world having 220 million smart phone users base with 80 million users in rural India (Anonymous, 2016). The cost of the smart phone device is becoming affordable and their feature allows creation of a variety of practical applications. Henceforth, it has a wide scope and potential of faster information dissemination, thus making the farmer empowered with information. However it is observed that the rural population still has difficulty in accessing crucial information in order to make timely decisions.

To overcome this problem, there is a need of using the available resources and technology to develop Mobile Application System as a decision support system for the small ruminant farmers in a cost effective manner. Moreover, many researchers have only developed information system for dairy cattle and hence the project on **"Development of Mobile Based Technology Transfer Application System to Empower the Small Ruminant Farmers in Tirunelveli District"** sponsored by the NABARD, Chennai is being implemented at Department of Veterinary and Animal Husbandry Extension Education, Veterinary College and Research Institute, Tirunelveli with the following objectives,

- To assess and prioritize the information needs of small ruminant farmers.
- To develop a need based Mobile Application System for small ruminant farmers.
- To study the effectiveness of Mobile Application System among the small ruminant farmers and other stakeholders.

STRATEGY ADOPTED

- A survey was conducted with well structured interview schedule to assess the information needs of small ruminant farmers of Tirunelveli District by involving all the stakeholders' viz. farmers, researchers, extension workers, middlemen, commodity interest groups, etc.
- Forty researchers from Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), 60 extension personnel from the State Animal Husbandry Department of Tirunelveli District and 100 small ruminant farmers of Tirunelveli Districts formed the respondents for the study. Accordingly, data were collected from researcher, extension personnel and small ruminant farmers.
- The information needs of small ruminant farmers were collected under six major sub-heads and a total of 24 information needs were identified. The information needs include topics on breeds and breeding (three), feeding (five), management (five), disease control (six) and marketing (five). The identified needs were prioritized based on which a mobile based technology transfer application system was developed.
- Suitable contents with relevant photographs and videos of breeds and breeding, feeding, management, disease control and marketing were developed in consultation with subject matter specialists of Veterinary College and Research Institute, Tirunelveli.
- The contents pertinent to the information needs were incorporated as an Android based Mobile Application Systems in English and Tamil languages with suitable text, video and audio etc.

The developed mobile app. in small ruminants uploaded and is available in Google play store (https:://play.google.com/store/apps/details?id=tanuvas.ac.in.sheepandgoatmobileap) which could be downloaded and installed to retrieve the information both in online and offline mode.

STRUCTURE OF THE MOBILE APP.

App. contents were organised into main and sub-menu. Main menu has breeding, feeding, management, disease control, marketing and others sections. Under Breed Sub-menu, content were organised into breeds and breeding management. Breeds section has Exotic, Indian and Tamil Nadu types of breeds. Breeding management section has details on traits of breeding and types of breeding.

Feeding sub-menu has green fodder, dry fodder, concentrate feed, feeding management and grazing management sections. Under concentrate feeding, preparations of concentrate feed, quantities of concentrate feed, were included. Under management sub-menu, floor space requirement, dentition, method of rearing, culling of animal, transport of goat / sheep, farm appliances were provided. Disease control sub-menu has bacterial diseases, viral diseases, parasitic diseases, deworming and vaccination schedule, ethno-veterinary medicine and first aid-medicine, etc.

Marketing sub-menu comprises of marketing channel, slaughtering goat, value added meat products, bankable project, livestock shandy etc. Other sub-menu has contact details of TANUVAS units and Animal Husbandry Department.

SPECIAL FEATURES

This app. has separate icons for special options like Push notification, WhatsApp, FAQ, MAP and Search. We can send important notification like forecasting, deworming and vaccination schedule to all end-users in a single stroke by using push notification option. By using WhatsApp option, we will share many innovative ideas and experiences in sheep and goat farming. FAQ options are obviously helpful to new entrepreneurs. We can locate the veterinary hospital, dispensary, college etc. by using MAP option. By using search option, we can find exact content what we need which saves time too.

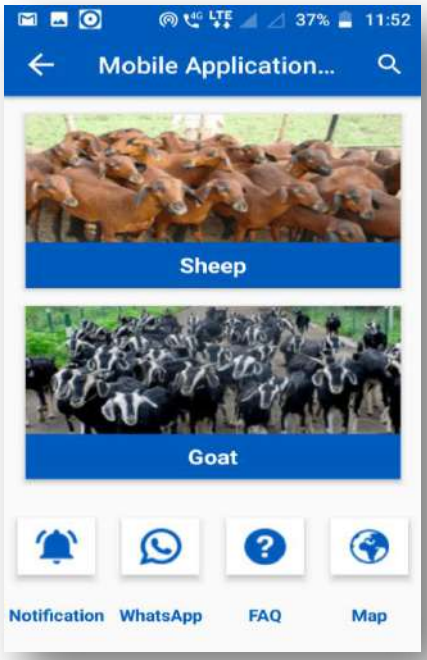
UTILITY

- This mobile app will help to impart the scientific knowledge on small ruminant farming system in local language to end users.
- This app is a one-time effort and can be used in a large number of places, which will ultimately save money, time and effort, in reaching a larger population.
- This app. is built to break the literacy barrier and deliver the information.
- Provides access to extension and advisory services.

CONCLUSION

Android based smart phones have penetrated urban as well as rural areas and ownership is distributed across various socio-economic data. Further, android based smart phone can be used to reach the widely scattered and diverse farming community. Hence, the mobile app. in sheep and goat farming will be useful to farmers, entrepreneurs and other stakeholders which would empower the farming community.

MOBILE APP. SCREEN SHOTS


37% 11:52
Mobile Application...
Sheep
Goat
Notification
WhatsApp
FAQ
Map


37% 11:52
ஆடு வளர்ப்பவர்க...
செம்மறி ஆடு
வெள்ளாடு
அறிவிப்பு
வாட்ஸ் ஆப்
கேள்வி
வரைபடம்

Quantitative Trait Loci (QTL) Mapping: The Basic Concepts

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ABSTRACT

The region of the genome or locus of a gene that is associated with an effect on a quantitative trait is known as Quantitative Trait Loci (QTL). The quantitative traits are controlled by several genes where all the genes have small effect which are additive in nature, affected by the environment. QTL mapping is based on the principle of co-segregation of marker locus and QTL together due to linkage between them. It is done with the use of molecular markers and appropriate statistical method. Different mapping populations for QTL analysis include double haploid lines, backcross and F_2 population and recombinant inbred lines. Various approaches used for QTL detection are single marker approach (SMA), simple interval mapping (SIM), composite interval mapping (CIM), multiple interval mapping (MIM). QTL mapping can be effectively used for gene pyramiding, germplasm screening of diversified material for abiotic (salinity, cold, salt, drought) and biotic stresses (disease, pest) etc.

INTRODUCTION

Quantitative Trait Loci (QTL) is defined as a region of the genome or locus of a gene that is associated with an effect on a quantitative trait. It is located using molecular markers and can be effectively used in Marker Assisted Selection (MAS). Many of the agriculturally important traits like quality, productivity, tolerance to abiotic stresses, resistance to diseases etc. are controlled by polygenes. These traits are referred to as quantitative traits and show continuous variation, it is also called as polygenic or multifactorial traits; the phenotypic performances of the plant controlled by this gene only partially reflect the genetic values of individuals. A quantitative trait can be controlled by a single gene or a group of linked genes with small additive more affected by environment.

QTL mapping helps to investigate the number of genes influencing the trait, its location and effect on various traits that have great importance in plant breeding (Khan,

2015). The effectiveness of QTL map is considered based on linkage and marker trait association; its various functions includes gene pyramiding, germplasm screening of diversified material for abiotic (salinity, cold, salt, drought) and biotic stresses (disease, pest) etc.

Principle of QTL analysis

The basic principle of QTL mapping is that gene and markers co-segregate *via* chromosomes recombination during meiosis, thus allowing their analysis in the progeny (Collard *et al*., 2005). The linkage between the marker and the target gene of interest should be tight enough to co-segregate. There will be a higher chance of crossing over if genes remain farther from the concerned genetic marker. It is confirmed based on the banding pattern of marker used.

Linkage disequilibrium is a situation where genes fail to segregate independently. QTL analysis is useful for incorporating genes into improved cultivars *via* marker-assisted selection (MAS), map-based cloning of the tagged genes, and for a better understanding of the genetics of complex traits (Asins, 2002).

GENERAL STEPS INVOLVED IN QTL MAPPING

i. Select parents that have differences between them in the alleles which affect variation in a trait.
ii. Develop an appropriate mapping population by crossing the selected parents
iii. Phenotype the mapping population for the trait(s) of interest (quality, yield, tolerance, resistance, etc.) under multiple locations so as to have a better understanding of the QTL x environment interaction if any.
iv. Genotype the population with molecular markers and generate the molecular data with adequate number of uniformly spaced polymorphic markers. The amount of precision of estimation of both QTL position and effect will be high if more number of markers is used.
v. Construct a genetic map
vi. Identify molecular markers linked to the trait(s) of interest by correlating phenotypic and genotypic data with an application of an appropriate statistical approach.

Mapping Populations

Many factors such as plant species, marker used, trait of interest, etc. are to be considered while choosing the type of mapping populations. The various types of mapping populations used in QTL analysis includes:

i. Double haploid lines (DHLs)
ii. Backcross (BC) population
iii. F_2 population
iv. F2:3/F2:4 lines
v. Recombinant inbred lines (RILs)

When a haploid cells undergoes chromosome doubling, doubled haploid (DH) is formed. Plants are regenerated from pollen and treated for chromosome doubling. DHLs represent a direct sample of the segregating gametes as the population has been generated by meiosis. Backcross (BC) population is generated by crossing back F_1 plants with one of the parents while, when F_1 plants are selfed, F_2 population is produced. F2:3/F2:4 lines are derived from selfing of the F_2 individuals in order to retain the individual's genetic constitution, also called F_2 families. RILs population represents an 'immortal' or permanent mapping population. It is derived by selfing individual F_2 plants and further single seed descent. The RILs and DH populations can be multiplied and reproduced without the occurrence of genetic change as they produce homozygous lines. Strong linkage disequilibrium at marker loci and allele of linked loci controlling the trait is essential feature of such type of population.

Construction of linkage maps

The position and relative genetic distances between markers along chromosomes are indicated by linkage maps. It is constructed by using data generated on any of the above-mentioned mapping populations. The relative order and distance between markers can be determined by analyzing the segregation of markers. They are considered to be situated closer on a chromosome if the frequency of recombination between two markers is lower, conversely, the higher the frequency of recombination between two markers, they are situated on a chromosome further. Regarding the recombination within marker intervals, co-dominant marker provides more information than dominant marker.

The linkage between markers is usually calculated with an odds ratio (i.e., the ratio of linkage versus no linkage), and it is expressed as the logarithm of the ratio and is called a logarithm of odds (LOD) value or LOD score (Risch, 1992). For the construction of linkage maps, LOD values of >3 is used.

QTL mapping is affected by the various factors such as the number of genes controlling the target traits and their position, the heritability of the traits, type and size of mapping population used in QTL mapping, type and number of markers in linkage maps and statistical method used. Commonly used software programs for constructing linkage maps includes JoinMap, Mapmaker/EXP, MapManager QTX, and THREaD Mapper Studio etc. and some of the QTL mapping softwares are MapMaker/QTL, MQTL, PLABQTL, QTL Cartographer, MapQTL, Qgene and SAS (Sehgal *et al*., 2016).

METHODS TO DETECT QTLS

Single Marker Approach (SMA)

This approach allows the quick scanning of whole genome and helps to determine the best QTLs by studying single-genetic markers one at a time. So, it is also known as a single factor analysis of variance or single point analysis. Some of the limitations of this approach are that it is unable to determine QTL positions, whether

the markers are associated with one or more QTLs and its accuracy is less compared to other methods. They are less likely to be detected statistically if the QTL is farther from the marker due to crossover events between the marker and the gene.

Simple Interval Mapping (SIM)

In this method, the presence of the QTL is determined at many positions between two mapped marker loci based on the likelihood ratio test, so it can also be called as two marker approach. SIM does not take into consideration the genetic variance due to other when various QTLs are segregating in a cross. It gives less accurate results than CIM and MIM techniques though this approach is better than single marker approach.

Composite Interval Mapping (CIM)

In this approach, the variance from other QLTs is also accounted by including partial regression coefficient from markers in other regions of the genome and thus minimizes the effects of various linked QTLs. Through this approach, mapping of multiple QTLs can be carried as well as it increases the precision of QTL mapping by eliminating as much as the genetic variance produced by other QTL.

Multitrait Interval Mapping (MIM)

It is the extension of interval mapping of multiple QTLs where phenotypes are regressed on QTL genotypes. The QTL genotypes are replaced by probabilities estimated from the nearest flanking markers. As it is used to map multiple QTLs, this approach is a potential tool for detection of QTL x QTL interaction.

CONCLUSION

The identified genes and its specific location by QTL mapping that controls the quantitative characters can be used in plant breeding programmes, including gene pyramiding , germplasm screening of diversified material for abiotic (salinity, cold, salt, drought) and biotic stresses (disease, pest) etc. With the development of DNA (or molecular) markers, preparation high resolution linkage map and identification of QTLs has become easier and reliable. The technique of QTL mapping and its use in marker-assisted selection should be adopted at large scale for all major agricultural crops.

REFERENCES

Asins, M. 2002. Present and future of quantitative trait locus analysis in plant breeding. *Plant Breed*, 121: 281-291

Collard, B.C., Jahufer, M.Z.Z., Brouwer, J.B. and Pang, E.C.K. 2005. An introduction to markers, quantitative trait loci (QTL) mapping and marker-assisted selection for crop improvement: the basic concepts. *Euphytica*, **142**(1-2): 169-196

Khan, S. 2015. QTL mapping: a tool for improvement in crop plants. *Research Journal of Recent Sciences*, 4**:** 7-12

Risch, N. 1992. Genetic linkage: interpreting LOD scores. *Science*, 255: 803-804

Sehgal, D., Singh, R. and Rajpal, V.R. 2016. Quantitative trait loci mapping in plants: concepts and approaches. In Molecular breeding for sustainable crop improvement. Springer, Cham. pp. 31-59

Horsegram: Potential source for food industries

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ABSTRACT

Food industries are in need of nutrient rich legume crops coupled with medicinal and health benefits. In Indian sub continent, an array of pulse crops is being predominantly cultivated in arid/semi-arid situations. Legumes yielding better in dry land situation with medicinal values are boon for food industries. Horsegram is one such multipurpose legume crop with immense nutritional advantage. It offers scope for formulation of many health recipes and drinks targeted for treatment of occupational diseases. This summarized article provides an opportunity to understand the importance of this vital legume and pave way for start-ups.

Keywords: Food industries, Horsegram, Functional foods

CROP INFORMATION

Horsegram is an ancient legume being cultivated in a wide range of environmental regimes. It is commonly called as poor man's pulse crop in India because of its immense nutritional benefits and drought tolerance. The cultivation of horsegram began with pre-historic period around 2000 B.C. The crop grows well in an altitude of 1000 m above sea level with temperature and humidity range of 25-30°C and 50-80% respectively. It is predominantly cultivated in southern states of India *viz*., Karnataka, Tamil Nadu, Maharashtra and Andhra Pradesh and to some extent in portions of Bihar, Himachal Pradesh, Orissa, Chhattisgarh, West Bengal and Uttar Pradesh. In Tamil Nadu, the crop covers an acreage of 38.60 thousand hectares with productivity of 320 kg / ha. Most of the horsegram cultivars prevailing in Tamil Nadu are photo-sensitive with maturity duration ranging from 95-180 days. It is largely preferred by marginal farmers and grown with less agricultural inputs. In southern India, horsegram

is widely cultivated during *rabi* season (Oct - Jan) with the help of residual moisture. This multipurpose legume thrives well in resource challenging environment compared to other major pulse crops. The US National academy of Sciences quoted horsegram as a potential food legume owing to its improved nutritional value.

Nutritional significance

Horsegram seeds possess excellent protein source (21.73%) compared to other major commercial legume crops *viz*., chickpea (18.77%), kidney bean (19.91%), pigeon pea (20.27%) and dry peas (20.43%). The major proteins found in legume are globulins (> 50%), glutelins (10 - 20 %) and albumins (10 - 20 %). Among the total proteins, albumin-globulin fraction accounts around 75 - 78 % in horsegram (Yadav *et al*., 2004). The albumin protein fractions are water soluble which enhances the bioavailability in poor man's diet. The seeds are consumed by boiling or frying with cooked rice and other major millets. It is also enriched with iron, calcium, magnesium, phosphorous, manganese, molybdenum and vitamins *viz*., carotene, vitamin C, riboflavin, niacin and thiamine (Table 1). It contains significantly higher lysine content compared to blackgram and pigeonpea. The other major amino acids reported in horsegram were arginine, histidine, lysine, valine and leucine.

Table 1. Nutrient composition of horsegram seeds

S. No		Constituents
1	Protein	22.6% 17.9% - 25.3% (whole seeds) 18.4% - 25.5% (dehulled seeds)
2	Fat	0.8%
a.	Saturated fatty acids	27.5%
b.	Unsaturated fatty acids	72.49%
3.	Moisture	11.39%
4	Carbohydrate	66.9%
5	Crude Fibre	1.6%
6	Dietary fibre	16.7%
7	Ash	2.9%
8	Calcium	238 mg / 100 g
9	Phosphorous	311 mg / 100 g
10	Iron	68.25 - 92.95 µg / g
11	Potassium	13.06 mg / g
12	Copper	10.28 - 13.16 µg / g
13	Manganese	31.26 - 59.85 µg / g
14	Nickel	1.04 - 1.33 µg / g
15	Zinc	29.24 - 38.13 µg / g
16	Thiamine	0.4 mg / 100 g
17	Riboflavin	0.2 mg / 100 g
18	Niacin	1.5 mg / 100 g

(Data courtesy: ICMR- National Institute of Nutrition)

HORSEGRAM AS FUNCTIONAL FOOD

"Nutraceuticals" are the foods or part of food that provide immense medical or health benefits which includes prevention, protection and treatment of a disease (Brower, 1998). Horsegram is a major component in Indian ayurvedic because of its enormous nutraceutical properties. The seeds are rich in unsaturated fatty acids with high proportion of linoleic acid. The increased linoleic content (42.78%) would be highly beneficial in treatment of diabetics and cardiovascular diseases. Crude fibre represents the one-seventh to one-half portion of dietary fibre. The high crude fibre content of horsegram helps to improve the dietary value by maintaining positive intestinal effects and colon physiology. Horsegram serve as an excellent remedy for common cold, cough, throat infection, fever, urinary diseases and piles. It act as an astringent, reduces blood cholesterol, helps to regulate abnormal menstrual cycle and also used in treatment of hiccups and worms. The bioactive peptides of horsegram protein possess anti-oxidant, anti-microbial and anti-carcinogenic activity. Recent scientific study revealed the anti-hyperglycemic property of horsegram, which plays an active role in treatment of diabetics.

CONCLUSION

Functional / health foods have gained wide popularity in the last few decades because of its medicinal synergy with no side effects. The success of nutraceutical products coupled with increasing health consciousness had resulted in rapid worldwide enhancement of functional food industries. Chemical compounds such as phenolics, flavonoids, soluble and insoluble dietary fibers, alkaloids, carotenoids, prebiotics, phytosterols, tannins, fatty acids and terpenoids were considered as major health promoting components at food industries (Patwardhan *et al*., 2005). Horsegram possess immense potential for utilization in food industries because of its wide health promoting benefits. An intense scientific exploration on suitability of horsegram to nutraceutical industries would highly benefit the malnourished areas of world.

REFERENCES

Brower, V (1998) Nutraceuticals: poised for a healthy slice of the healthcare market? Nat Biotechnol., Vol.16:728-731.

Yadav, S., K.S. Negi, S. Mandal (2004) Protein and oil rich wild horsegram. Genet. Resour. Crop Ev., Vol.51:629-633.

Patwardhan, B., D. Warude, P. Pushpangadan, N. Bhatt (2005) Ayurveda and traditional Chinese medicine: a comparative overview. eCAM Vol.2: 465-473.

Utility of Indian cow derived products: Panchagavya

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ABSTRACT

Panchagavya is a term used to describe five major substances, obtained from cow, which include cow's urine, milk, ghee, curd and dung. Each ingredients of Panchagavya have many beneficial properties and used extensively in Ayurvedic preparations. This type of treatment is called Panchgavya therapy or cowpathy. Its antimicrobial properties have gained the attention of the medical and veterinary professionals. Cow dung and urine have excellent properties for making biofertilizers and biopesticides. Cow urine possesses antimicrobial, fungicide, anthelmintic, bioenhancer, antiseptic and anticancerous properties. Indigenous cows produce A2 type milk and is a rich source of Vitamin B2, B3, Omega-3 fatty acids with higher Conjugated Linoleic Acid (CLA) and natural antioxidants. Cow curd is a best probiotic and is useful in gastro-intestinal ailments. Cow ghee has immunostimulatory properties, antioxidant property and prevent atherogenesis. In the past expected importance has not been given to the Panchagavya therapy which needs attention of scientific community.

Key words – Panchagavya, ayurvedic preparations, A2 milk, immunostimulatory properties.

INTRODUCTION

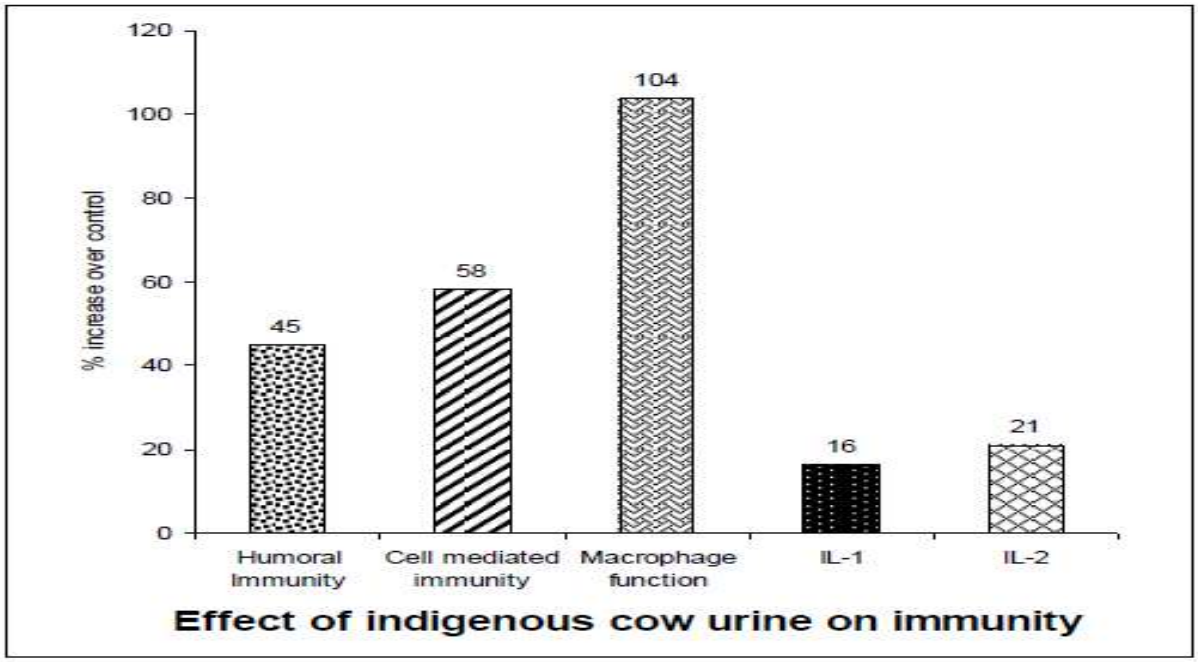
According to History, Maharshi Vasishtha served the divine "Kamdhenu" Cow and Maharshi Dhanvantari offered to human being a wonder medicine "Panchgavya" (a combination of cow urine, milk, dung, ghee and curd). 'Panchagavya' is a traditional product prepared by fermenting dung, urine, milk, curd and clarified butter (ghee) from Indian cow (Somasundaram *et al.*, 2007). It is used as a medicine and as well as fertilizer for plants (Preethi et al. 1999). All the five product used for medicinal purpose

singly or combination with other herbs. In Ayurveda, the ancient Indian system of medicine, has detail mentions of importance of cow's milk, curd, ghee, urine in the treatment of various human aliments (Dhama *et al.*, 2005).

BENEFICIAL PROPERTIES OF EACH INGREDIENTS OF PANCHAGAVYA

Cow urine

The cow' is a mobile medical dispensary and cow urine is a panacea of all diseases (Pathak *et al* ., 2003). Used extensively in ayurvedic preparations. It's value described in Charaka Samhita, Sushruta Samhita, Atharva Veda, Amritasagar, etc. Gomutra is capable of curing blood pressure, blockage in arteries, arthritis, diabetes, heart attack, cancer, thyroid, asthma, psoriasis,eczema, prostrate, fits, AIDS, piles, migraine, ulcer, acidity, constipation, gynecological problems, ear and nose problems and several other diseases (Jain *et al.,* 2010).



Therapeutic Value of Cow Urine According to its Composition

S. No.	Name of chemical	Effect of chemical on diseases
1.	Ammonia	Stabilise bile, mucous and blood formation.
2.	Aurum Hydroxide (AuOH)	It is germicidal and increases immunity power. It is highly antibiotic and anti-toxic.
3.	Calcium	Blood purifier, bone stregthener
4.	Carbolic Acid	Germicidal, stops growth of germs and decay due to gangrene.
5.	Copper	Controls built up of unwanted fats

6.	Creatinin	Germicidal
7.	Enzymes	Make healthy digestive juices, increase immunity
8.	Hipuric Acid	Removes toxins through urine
9.	Iron	Helps in production of red blood cells & haemoglobin.
10.	Manganese	Germicidal, stops growth of germs.
12.	Nitrogen	Removes blood abnormalities and toxins, activates kidneys and it is diuretic.
13.	Other Minerals	Increase immunity
14.	Phosphate	Helps in removing stones from urinary track
15.	Potassium	Removes muscular weakness and laziness.
16.	Salt	Decreases acidic contents of blood, germicidal
17.	Sodium	Purifies blood, Antacid
18.	Sulphur	Supports motion in large intestines, Cleanses blood.
19.	Urea	Removes blood abnormalities and toxins, activates kidneys and it is diuretic.
20.	Uric Acid	Removes heart swelling or inflammation.
21.	Vitamins B complex	Vitamin B is active ingredient for energetic life and saves from nervousness and thirst, strengthens bones and reproductive ingredient
22.	Water	It is life giver. Maintains fluidity of blood, maintains body temperature.

(Sahu, 2016)

OTHER BENEFICIAL PROPERTIES OF COW URINE

Antimicrobial property-

Inhibitory activity against growth of both Gram-positive and Gram-negative bacteria was evident (Yadav *et al*., 2008).

Ex.- Antimicrobial activity was seen against bacterial pathogens *Bacillus cereus, Staphylococcus aureus, Salmonella typhimurium, Aeromonas hydrophila, Enterobacter aerogenes,* and *Micrococcus luteus.*

Fungicide

Fungicidal effect against *Aspergillus fumigatus, Aspergillus flavus, Aspergillus niger, Aspergillus, Malassezia, C. tropicalis and C. glabrata* has been observed in various studies (Kumar and Mali 2002).

Potent bio fertilizer and bio pesticide

Cow urine can kill a number of pesticide and herbicide resistant bacteria, viruses and fungi making it useful in agricultural operations.

Prevention of antibiotic resistance

Different study has been shown that CU (Cow Urine) is much effective against the drugs resistant bacteria and viruses.

Ex- Vancomycin resistant Enterococcus, and ciprofloxacin resistance P. aeruginosa are some of the examples (Randhawa *et al.,*2015).

Anthelminthic Activity -Cow urine was found to be anthelmintic agent at both 1% and 5% concentrations (Kekuda *et al.*, 2010).

Bioenhancer-Cow urine is the only agent of animal origin which acts as bioenhancer of antimicrobial, antifungal, and anticancer agents (Kekuda *et al.*, 2010).

Antiseptic - It is observed the enhanced wound healing activity of Cow urine in Wistar albino rats.

Anticancerus activity - Cow urine has antioxidant properties and is a free radical scavenger, and thus it neutralizes the oxidative stress. Cow urine effective as anti-cancer therapy because it helps the lymphocytes to survive by inhibiting their apoptosis and by repairing the damaged DNA (Kumar *et al.,*2004 and Ambwani, 2004).

Effect on Crop production

- **Increase plants growth and yield -** Cow urine could be a potent source to improve soil fertility, crop productivity and quality. This can also be a potential alternative for fertigation which is becoming common in most of the crops (Pathak and Ram., 2013). A study was conducted on effect of two foliar sprays of different concentrations of cow urine (2%, 4%, 6%) at 25 and 40 days after sowing on soybean. Result showed a concentrations of 6% was more effective in enhancing the morpho-physiological, chemical biochemical and yield and yield contributing parameters when compared with control.
- **Increase nutrient content and uptake in plants-** The nutritional effect of cow urine on Trigonella foenum-graecum (Methi) and Abelmoschus esculentus (Bhindi) plants showed increased chlorophyll and protein content with increased concentration of urine as compared to control (Jandaik *et al.,* 2015**)**
- **Maintain soil physical and chemical properties-** Cow urine application has also reported to improve the soil texture and structure. High dose of Liquid Cow Manure application resulted in increased pH and EC values, nutrients and Dissolved Organic Carbon content of amended soils.
- **Increase soil microbial population and crop yield -** Compost tea (cow dung+cow urine+water) contains high amounts of microbes which have complementary effect on the native microbes and also favour decomposition of organic matter at a faster rate which, result in better transformation of nutrients and their availability to crops (Pathak and Ram, 2002)
- **Insect control -**In Ethiopia, the pest was controlled with water extract of neem, *Nicotiana tabacum* L., *Capsicum annuum* L. or *Allium cepa* L. mixed with fermented cow urine (Tesfaye and Gautam, 2003)

COW DUNG -

The native Indian cow/cattle dung also has many useful properties. It is high in organic matter and rich in nutrients. It contains about 3% nitrogen, 2 % phosphorous and 1% potassium. Therefore, native cattle dung are excellent ingredients for making bio-fertilizers and bio pesticides (Compost, 2017). The Indian cow dung also contain higher amount of calcium, phosphorus, zinc and copper than the cross-breed (Garg and Mudgal

2007; Randhawa and Kullar 2011) . Cow dung harbours a rich microbial diversity, containing different species of bacteria (*Bacillus* spp., *Corynebacterium spp. and Lactobacillus spp.),* protozoa and yeast (*Saccharomyces and Candida)* (Nene 1999; Randhawa and Kullar 2011).

Cow dung is antiseptic and have prophylactic (disease preventive) (Dhama *et al* 2005) Cow dung decreases the amount of pollutants in soil and also helpful in increasing nutrients of soil as well as helpful in enhancement of soil properties like water holding capacity, softness etc for enhances growth of plant .

Milk

- Indigenous cow milk possesses less cholesterol and high protein having high biological and nutritional value.
- It is easily digestible and extensively used in *Ayurvedic medicines for treatment of* various ailments.
- Milk from indigenous breed of cow is known to have better therapeutic values.
- It is rich source of Vitamin B2 and B3 a natural antioxidant.
- Microbes like *Lacto bacillus present in it, produce* organic acids that promote crop growth and resists pathogens and a biotic stresses
- It is a rich source of Omega-3 fatty acids with higher CLA (Conjugated Linoleic acid) (Pathak, 2013)
- Antimicrobial activity is due to immunoglobulins (IgA) ,lactoferrin, lysozyme ,lactoperoxidase and vitamin B12 binding protein.
- lactoferrin B shows marked antifungal activity (Bellamy *et al.*,1994).
- The amino acid proline has been found to systematically induce resistance in plants.
  Ex.-Chilli against leaf curl (Kumar and Mali, 2002).
- Indegenous cow produce only A2 type milk have benificial properties

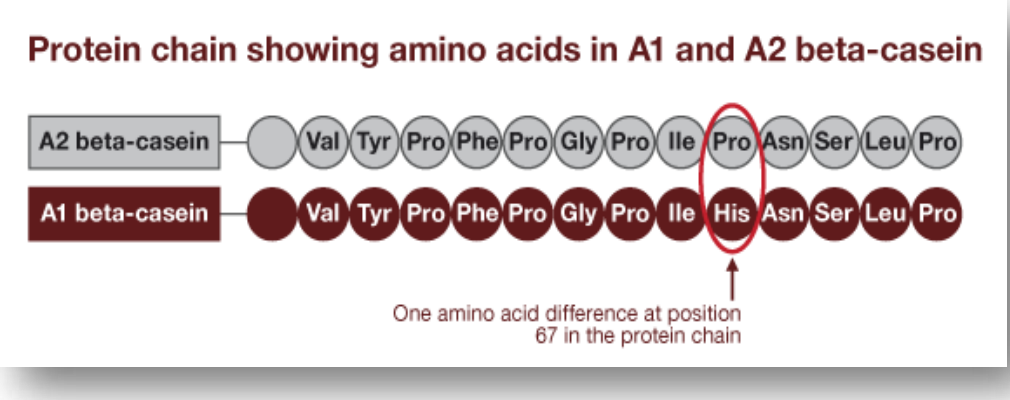


Fig: difference between A1 and A2 beta casein

Difference between A1 and A2 milk

s. no	**A1 milk**	**A2 milk**
1.	Contain A1 beta casein	Contain A2 beta casein (Woodford, 2007)
2.	Found in cow's milk in Europe, USA ,Australia ,New Zealand (Reddy, 2017)	Found basically in indigenous cows and buffaloes in India
3.	The status of the A2 allele of beta casein gene is 60%	The status of the A2 allele of beta casein gene is 100% (Sharma, 2013)
4.	Relationship with many human disease like allergies obesity , CVD , type 1 diabetes, autism ,schizophrenia etc (Elliott *et al*, 1999)	Dosenot cause such type of illness.
5.	Less as compare to A2	More omega 3 fatty acid in milk
6.	Calcium to magnesium ratio is 10:1, higher than ideal	Calcium to magnesium ratio is 2:1(Reddy *et al.,* 2016)

COW CURD

Cow Curd (*dahi*) or *Matha* (whey or butter milk) prepared from indigenous cow is milk is considered as digestive, nutritive and useful in gastrointestinal ailments by checking or controlling the growth of harmful organism. Whey/butter milk is very low in fat but has large amount of beneficial bacteria or their breakthrough products in the form of amino acids, peptides, vitamins, minerals etc., which are nutritionally useful in human and animal health. These bacteria attaich on the intestinal surface and further multiply there. *Lactobacillus acidophilus* bacteria plays vital role, making the whey more useful. It has been exploited as probiotic to control animal diseases: by improving in intestinal microbial balance (Dhama *et al.* ,2005)

Cow curd and butter milk is reliable digestive nutrient and useful in gastroentestinal ailment (Singh and Chauhan, 2004) . Concentrated whey increase draught power in bullocks. (Singh and Chauhan, 2004) . Large amount of lactic acid producing bacteria present in curd and buttermilk produce antifungal metabolites (Schnurer and Magnusson, 2005).

With the help of probiotics, there is a hope to control infections in a non-drug manner. It will also reduce the consumption of antibiotics in animal husbandry. The residues of antibiotics in milk, egg or poultry meat are the cause of several deleterious effects in man including allergy and resistance of infections. Such problems will bet reduced after the use of probiotics particularly in the form of cow curd. However, there is still need of a huge amount of research work to scientifically validate and revalidate the indigenous cow curd/*matha* as probiotics.

COW GHEE

Cow ghee (butter-fat) is traditionally believed to improve memory, voice, vision, intelligence and body's resistance to infections. (Dhama *et al*., 2005) . Conjugated linoleic acid in ghee increased antioxidant activity and prevented atherogenesis. It has immunostimulant potential it increase neutrophil adhesion and delayed type hypersensitivity (DTH) responses in rats. (Fulzele *et al.,* 2001) . Cow ghee fascilitate healing of wound when used in combination with honey (Kaur *et al.*, 2001) . It exhibits antichollestric activity, and immunostimulant activity. Ayurvedic practitioners believe that cow's milk and *ghee* are memory enhancers. The doctors recommend not to use any fat except cow *ghee* by a cholesterol patient. The use of cow *ghee* does not increase cholesterol and has no bad effect on heart.

Cow butter is a blood purifier and increases the beauty. Cow *ghee* promotes healing of wounds. It is helpful in preventing and controlling paralysis and asthma. The *ghee* obtained from cow milk is very much useful for persons having weak eyesight.

HOW TO PROMOTE PANCHGAVYA

- The use of *Gobar* (cow dung) and *Gomutra* (cow urine) of indigenous breeds of cattle should be promoted extensively by educating farmers the benefits of different manures/bio-fertilisers, composts, pest-repellents, pesticides and biogas prepared by cow dung and urine. It can reduce the cost of production and as a long term measure for sustainable and healthy agriculture production.
- Centers should be established and recognized for promotion of the production and use of Panchagavya as an alternative source of energy, such as *Gobar* gas, alternative methods of farming and to initiate, undertake and promote research and innovations in the field of utility and contribution of cow, its progeny and other cattle to the agriculture and bio-diversity including bioenergy and biofertilizers etc. for bio-friendly environment.
- Proper attention should be given on Panchagavya therapy for inducing protection against several diseases in the livestock/poultry populations. There should be requirement of more researches for the verification of clinical and medicinal claims made in ancient literature related to medicinal properties of Panchgavya products.
- Comparative chemical, microbiological and immunological analysis of Panchgavya of various indigenous cattle breeds with special reference to their agricultural, medicinal and nutritional importance should be evaluated scientifically.
- A sound data-base or data-collection system be developed for economic contribution of cattle products and bi-products.
- There is need to give more attention to Panchgavya in Veterinary College, Research Institutes Universities and Hospitals. Research programmes should be undertaken, encouraged and supported in national institutions, universities and non-government institutions. Krishi Vigyan Kendras and nongovernment organizations (NGOs) should be encouraged for promoting Panchgavya

CONCLUSION

Cow is Central to our life and part of bio- diversity. Its progeny and its Panchgavya have wide applications and have the potential for sustainable agriculture production, health and nutrition of humans, production of biofertilizers production of non-conventional energy and for maintaining the bio-diversity of the ecosystem. Thus it can be conclude that Panchgavya/Cowpathy, a new version of ancient science, is definitely a promising formulation in the years to come. However ,application of panchagavya in treating diseases needs much promotional activities since only limited researches are available. A combined effort of scientist, researchers and clinicians will definitely strengthen this alternate low cost therapy having no side effects, and thus can encourage confidence in the public about its good properties. Necessary support of scientists as well as researchers and clinicians is requires in order to strengthening the beneficial effects of cow urine therapy and other panchagavya elements, which will encourage both physicians and public to promote this wonderful therapy for the health benefits and help fighting various diseases and disorders of both animals and humans.

REFERENCES

Ambwani, S. (2004). PhD Thesis. Pantnagar, India: Submitted to Department of Biotechnology and Molecular Biology, College of Basic Sciences and Humanities, GBPAUT.Molecular studies on apoptosis in avian lymphocytes induced by pesticides.

Compost, C. (2017). Composting Cow Manure: Using Cow Manure Fertilizer in The Garden. Gardening Know How. Read on 16.05.17. https://www.gardeningknowhow. com/composting/manures/cow-manure-compost.htm.

Dhama, K., Chauhan, R.S. and Singhal, L.K. (2005). Anti-cancer activity of cow urine: current status and future directions. *International Journal of Cow Science,* 1(2): 1-25.

Dhama, K., Rathore, R.,Chauhan R.S. and Tomar, S. (2017). Panchagavya (Cowpathy): An Overview **,** *International Journal of Cow Science*, 1(1): 1-15.

Fuizele, S.V., Satturwar, P.M. and Dorle A.K. (2001). Immunostimulant activity of cows ghee .*J. Immunology,Immunopathology* ,3(2): 87-88.

Elliott, R., Harris, D., Hill, J., Bibby, N. and Wasmuth, H. (1999). Type I (insulin-dependent) Diabetes Mellitus and Cow Milk: Casein Variant Consumption. Diabetologia, 42 (3),292-296. Read on 10.04.17. https://link.springer.com/article/10.1007%2Fs001250051153

Garg, A.K. and Mudgal, V. (2007). Organic and mineral composition of Gomeya (cow dung) from Desi and crossbred cows—a comparative study. *Int J Cow Sci* 3:1–2

Jain, N.K., Gupta, V.B., Garg. R. and Silawat. N. (2015). Efficacy of cow urine therapy on various cancer patients in Mandsaur District, India - A survey. *Int J Green Pharm* 2010; 4: 29-35. Jandaik S, Thakur P, Kumar V. Efficacy of cow urine as plant growth enhancer and antifungal agent. Adv. Agri.7. Article ID 620368.

Jandaik S, Thakur P, Kumar V. Efficacy of cow urine as plant growth enhancer and antifungal agent. Adv. Agri., 2015, 7. Article ID 620368.

Kaur, S., Dayala, R,,Varshney, V.K. and Bartley, J.P.(2001). GC –MS analysis of essential oils of heartwood and resin of Shorea Robusta .Planta med. 67 : 883-886.

Kekuda, P.T., Nishanth, B.C., Kumar, P.S., Kamal, D., Sandeep, M. and Megharaj, H.K. (2010). Cow urine concentration: A potent agent with antimicrobial and anthelmintic activity. *J Pharm Res.*3:1025–7.

Kumar, A. and Mali, P.C. (2002). Response of bio control agents in relation to acquired resistance against leaf curl virus in chili. *Asian Congress of Mycology and Plant Pathology*, 1-4 October. pp. 266-67.

Kumar, A., Kumar, P., Singh, L.K. and Agrawal, D.K. (2004). Pathogenic effects of free radicals and their prevention through cowpathy. Indian Cow.6:27–34.

Nene, Y.L. (1999). Utilizing traditional knowledge in agriculture. Traditional knowledge system of India and Sri Lanka, pp 32–38

Pathak, M.L. and Kumar, A. (2003). Gomutra -descriptive study. *Sachitra Ayurveda*; 7: 81-84

Pathak, R.K. and Ram, R.A. (2013). Bio-enhancers: A potential tool to improve soil fertility, plant health in organic production of horticultural crops. Progressive Horticulture. 2013; 45(2):237-254.

Preethi, R., Devanathan, V. and Loganathan, M.(2010). Antimicrobial and antioxidant efficiency of some medicinal plants against foodborne pathogens. *Adv. Biol. Res.* 4: 122–125.

Randhawa, G.K. and Sharma, R. (2015). Chemotherapeutic potential of cow urine: *A review,Journal of Intercultural Ethnopharmacology*. Apr-Jun,Vol-4,issue-2:180-186.

Randhawa, G.K. and Kullar, J.S. (2011). Bioremediation of pharmaceuticals, pesticides, and petrochemicals with gomeya/cow dung. *ISRN Pharmacol*. doi:10.5402/2011/362459.

Reddy, O.S.K. (2017). https://www.linkedin.com/pulse/difference-between-indian-native-a2-cow-milk-cross-breed-osk-reddy.

Reddy, P. R. K., Reddy A.N., Ramadevi A. and Srinivasa D. K. (2016). Nutritional Significance of indigenous cow milk with regard to A2 beta casein. *International Journal of Science*, *Environment and Technology*, Vol. 5, No 5, 2016, 3376 – 3380

Sahu, R. K., Ramya, N.K.P. and Poluru, A. (2016). Cow Urine Therapeutic Value. *International Journal of Livestock Research* Vol 6 (11) : 98

Sharma, D. (2013). It's high time the world shifts to A2 milk. [Blog] Ground Reality. http://devinder-sharma.blogspot.in/2013/11/a2-milk-is-what-india-needs-to-drink.html.

Singh, B.P. and Chauhan, R.S. (2004). Cow dahi or matha :as probiotic to control animal disease .The Indian Cow. 2:39-49 .

Somasundaram, E., Amanullah M.M., Vaiyapuri, K, Thirukkumaran, K. and Sathyamoorthi, K.(2007). Influence of organic sources of nutrients on the yield

and economics of crops under maize based cropping system. *J Appl Sci Res*. 3:1774e7.

Schnürer, J. and Magnusson, J. (2005). Antifungal lactic acid bacteria as biopreservatives – review. *Trends in Food Science and Technology,* 16(1-3): 70-78.

Tesfaye, A. and Gautam, R.D. (2003) Traditional pest management practices and lesser exploited natural product in Ethiopia and India: Appraisal and revalidation. *Indian Journal of Traditional Knowledge*. 2:189-201.

Woodford, K. (2007). Devil in the milk. White River Junction, Vt.: Chelsea Green

Yadav, B.K. and Lourduraj, A.C. (2005). Use of Panchagavya as Growth Stimulant and Bio pesticide in Agriculture. In: Environment and Agriculture (ed. Arvind Kumar). APH Publishing Corporation, New Delhi.

Tomato leafminer, *Tuta absoluta*(Meyrick) (Lepidoptera: Gelechiidae): A new invasive pest in India

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ABSTRACT

The incidence of the South American tomato leafminer, *Tuta absoluta*(Meyrick) (Lepidoptera: Gelechiidae) is being reported for the first time as an invasive pest on tomato and potato in India. This invasive pest is recorded for the first time infesting tomato crop in the state of Maharashtra from Pune during 2014 and it was reported by Indian Council of Agricultural Research (ICAR), New Delhi. This pest alone cause up to 90% loss of yield and fruit quality under greenhouse and field Condition (Manju Thakur, 2015). The immature stage *i.e.* larvae were usually observed to feed on leaves, creating blotch-like mines visible from both sides of the leaf and several mines were found on a single leaf. In addition to leaf, they also feed on apical buds, stalks and boring the fruits. As a result, infested fruits showed distinct holes mainly in the upper half towards fruit stalk and usually enclosed with fecal mass. The promising bio-control agent *i.e.* mirid bug, *Nesidiocoris tenuis* (Reuter) (Hemiptera: Miridae) was recorded as potential predator on eggs and early larval stages of *T. absoluta* under field conditions. Therefore, there is a crucial need to set up suitable management practices to prevent further spread of this potential pest.

INTRODUCTION

Incidence of the tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in India reported by Indian Council of Agricultural Research. This pest has several common names like tomato borer, South American tomato moth, tomato leaf miner and South American tomato pinworm. As we know that, tomato is one of the important vegetable grown in India with 8.8 lakh ha area with a production of 19.6 M mt. Similarly, potato is another important solanaceous vegetable grown in 21.6 lakh ha with a production of 46.5 M mt (NHB, 2016-17). *T. absoluta*, is a neotropical, oligophagous pest infesting many solanaceous crops. In Europe, *T. absoluta* presence was initially reported

in the Eastern Spain in the late 2006 (Urbaneja *et al*., 2007), thereafter, it was recorded in Morocco, Tunisia, France, Italy, Netherlands, Albania, Portu gal, Bulgaria , Cyprus, Germany, Israel, Hungary, Greece, Bahrain, Iraq, Isreal, Japan, Jordan, Kuwait, Qatar, Saudi Arabia, Syria, Turkey, Yemen, Ukraine and other countries (CABI, 2014). Wide dissemination of *T. absoluta* is mainly correlated with fruit import and further distribution (Potting, 2009). The possible pathways for a long distance dissemination of *T. absoluta* could be through packaging materials (boxes) from infested countries (EPPO, 2010). After its initial detection, this has become the most serious pest causing severe damage on tomato in many areas (Germain *et al*., 2009). Cost-benefit analysis showed that *T. aboluta* significantly increased costs of pest management, primarily as a result of increased use of insecticides (Thomas, 1999; Lietti *et al*., 2005). As per report said, tomato leafminer can cause crop losses up to 100% and it is considered a key pest of greenhouse and open-field tomato (Arturo *et al.*, 2012). They are multivoltine having nearly 12 generations per year. According to its rapid population growth this pest, it should be treated as r-selected species (Pereyra and Sanchez, 2006). The rapid growth, potential natural dispersal and resistance to insecticides (Desneux *et al*., 2010) render this pest as the most serious threat for tomato production systems worldwide.

Distribution:

T. absoluta is a global major destructive invasive pest was found to be taking place in India in the year 2014. The pest has spread from South America to several parts of Europe, entire Africa and has now spread to India (krameash, 2015).

Host range

In the present study, the prevalence of *T. absoluta* was noticed on two hosts *viz*., tomato as well as potato and the incidence were higher on tomato than potato. Reports indicated that the main host plant of *T. absoluta* was tomato (*Lycopersicon esculentum*) although the insect has also been reported on solanaceous weeds, including *Solanum nigrum* and *Datura stramonium*. Damage has also been reported on egg plant (*Solanum melongena*), pepper (*Capsicum annuum*) and potato (*Solanum tuberosum*) (Pereyra and Sanchez, 2006). Although, tomato trade is one of the main aspects for a long distance dissemination of *T. absoluta*, short and medium natural spread immediate to invasion is a matter of great concern. They may proliferate during summer months in outdoors but it is not expected to survive winter conditions because its development stops between 6º and 9°C (Barrientos *et al*., 1998). Alternative host plants, especially *S. nigrum*may played a vital role in fast and incessant spread of this pest. There needs to be a continuous watch for the spread of *T. absoluta* on the already recorded and any of the new host plants in India.

Life cycle

Egg: It lays oval-cylindrical egg usually observed singly, but also in groups of 2-5 on the underside of leaves, on buds, or on the calyxes of green fruit. The color of eggs is cream-colored and small, about 0.2 mm in diameter and less than 0.4 mm in length and it took 4-5 days to hatch (slower under cool conditions).

Larva: Initial instars are white or cream with a black head. As larvae grew older, they turned greenish to pink with a brown head. The prothoracic shield is pale, with darker shading along posterior margin. They generally feed inside leaves, stems or fruit. Larval duration is approximately 8-14 days (slower under cool conditions). Usually fourth instar exits from feeding locations to pupate.

Pupa: They are less than 6 mm long, light to dark brown in color, cocoons are constructed mostly in soil level, but also in leaf mines and folded foliage, singly. They are mostly hided or camouflaged by foliage or sand/dirt particles. Pupal duration is approximately 7-10 days (slower under cool conditions).

Adult: They are active at night. Moths are small with a body length of about 5-7 mm. Adult body is brown or silver with black spots on the narrow wings. Antennae are filiform with bicoloured segments. They lay up to 260 eggs (most eggs are laid within the first week). Adult duration is approximately one to two weeks in summer (longer in cool environments) (Sridhar *et al.,* 2014, SA-DAFF, 2017)

Complete life cycle

They complete their lifecycle at three weeks in summer much longer in winter environments.

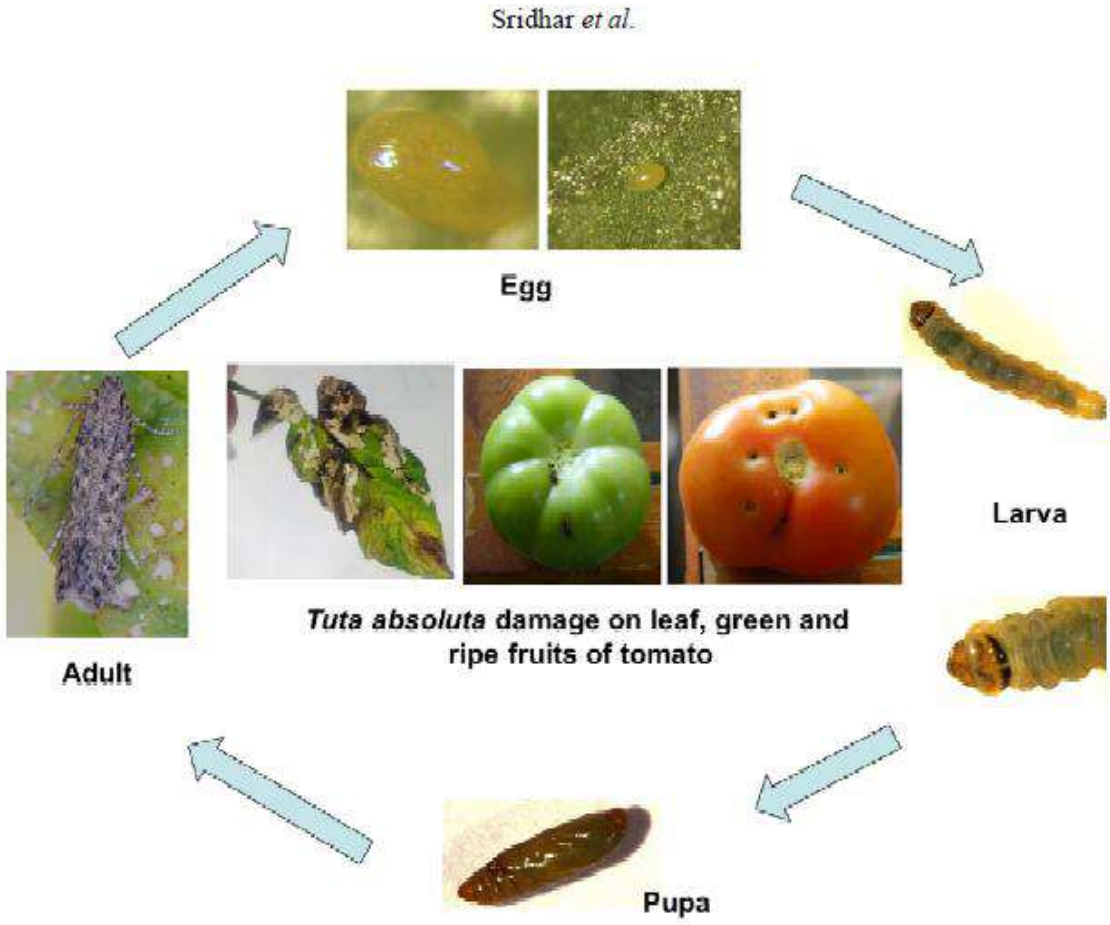

Fig. 1. Life cycle and damage symptoms of *T. absoluta*

NATURE OF DAMAGE

Immediately after emergence, young larvae of *T. absoluta* mined into tomato leaves, apical buds, stalks or fruits. As a result of feeding shows conspicuous mines (blotches) and galleries on leaves and pinhole sized holes on fruits from the stalk end generally covered with the frass. They mostly attacked leaves, creating blotch/leaf mines visible from both sides of the leaf. Numerous mines were observed on a single leaf. The mines have dark frass (excrement) visible inside and the mined areas turned brown and dried over time. This pest alone can cause up to 90% loss of yield and fruit quality under greenhouses and field conditions (Sridhar *et al.,* 2014).

MANAGEMENT STRATEGIES

Integrated Pest Management (IPM)

Principles of IPM, applicable to *Tuta absoluta*, include the following (SA-DAFF-2017):

- Sanitation
- Crop rotation
- Monitoring
- The roles of natural enemies (biological control)

Sanitation

Sanitation is defined as the removal, destruction or decontamination of any material/area that may contain living stages of a pest. These may include:

- infested plants, or parts of plants
- residues in harvested fields or greenhouses
- discarded parts of plants or fruit
- solanaceous weeds, including volunteer plants
- previously used greenhouses
- used containers

Crop rotation and monitoring

Crop rotation

The areas which are known for problems of *Tuta absoluta*, and where more than one crop can be planted, it is recommended to rotate crops with ones that are not known to harbour the pest. Crops that are not affected by *Tutaa bsoluta* mostly include plants in families other than the Solanaceae.

Monitoring with pheromone traps

- *Tuta absoluta* pheromone lures, placed inside Delta traps are used to monitor male moths.
- Self-made water pan trap (soap added) can be used.
- Traps should be placed out before, or as soon as crops are planted (to determine pest pressure).

Fig. 2.Delta trap

Biological control

Biological control is defined as the control of one living organism with another living organism. In the insect pest environment, these include:

- predators
- parasitoids
- diseases

All three occur naturally, and some, e.g. the entomopathogenic fungus, *Beauvaria bassiana* and Bacteria, *Bacillus thuringiensis*, are commercially available to control *Tuta absoluta.*

- Predators are wide feeders, also feeding on other pests, e.g. the Mirid bug, *Nesidiocoris tenuis* (Reuter) feeding on an aphid. Mirids are known to feed on *Tuta absoluta* eggs, as well as larvae when encountered outside mines.
- Parasitoids are usually minute wasps that lay their eggs on, or nearby eggs or larvae of pests. Several parasitoids of the potato tuber moth already occur in South Africa, and may attack *Tuta absoluta* in the field.

Chemical Control

- The application of imidacloprid in the irrigation water at 8-10 days after planting.
- Spray of spinosad 45 SC or indoxacarb 14.5 SC if occasional individuals of *Tuta absoluta* are observed.
- In case of pheromone trap catches less than ten moths per trap per week, then control treatments are recommended to be carried out mainly with bio-rational products, such as Bacillus thuringiensis and Azadirachtin.
- In case of pheromone trap catches more than ten moths per trap per week control, treatments are recommended to be carried out by combining bio-rational insecticides with synthetic chemical insecticides.
- In low population densities mass trapping of the pest with pheromone baited water traps has also proved to be an effective control measure in Spanish outbreaks. An Average of 30-40 pheromone baited water traps should be placed per hectare of water. Mass trapping provide an environmentally friendly control measure (Krameash, 2015).

CONCLUSIONS

T. absoluta has been a serious pest of tomatoes and farmers have gradually come to understand that conventional insecticides such as organophosphates and carbamates are not effective against the insect. Even though more expensive compared with other

insecticides, spinosad (Tracer) is now the widely used bio-insecticide to manage the insect. The use of insecticides to control *T. absoluta* must not divert attention from the implementation of alternative pest management strategies including cultural, mass-trapping and biological control that can reduce reliance to chemical products.

REFERENCE

Arturo, C., Salvatore, D. and Gavino, D. 2012. Integrated control in protected crops. *Mediterranean Climate IOBC-WPRS Bulletin,* **80**: 319-324.

Barrientos, Z.R., Apablaza, H.J., Norero, S.A. and Estay, P.P. 1998. Threshold temperature and thermal constant for development of the South American tomato moth *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). *Ciencia e Investigacion Agraria*, **25**: 133-137.

Biology, Damage and Control, a South African Perspective, https://www.sutherlandseedlings. co.za/wp-content/uploads/2017/02/2Tuta-absoluta-SA-DAFF-Task-Team-Presentation.pdf

CABI, 2014. Crop Protection Compendium. http://www.cabicompendium.org

Garcia, M. F. and Espul, J. C. 1982. Bioecology of the tomato moth (*Scrobipalpula absoluta*) in Mendoza, Argentine Republic. *Revista de Investigaciones Agropecuarias* **17**: 135 .146.

Germain, J.F., Lacordaire, A.I., Cocquempot, C., Ramel, J.M. and Oudard, E. 2009. Un nouveau ravageur de la tomate en France: *Tuta absoluta. PHM-Revue Horticole*, **512**: 37-41.

Krameash, 2015. Tomato pinworm (*Tuta absoluta*): A new invasive pest to India | agropedia http://agropedia.iitk.ac.in/content/tomato-pinworm-tuta-absoluta-new-invasive-pest-india

Lietti, M. M. M., Botto, E. and Alzogaray, A. R. 2005. Insecticide resistance in Argentine populations of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). *Neotropical Entomology,* **34**: 113-119.

Manju, T. 2015. *Tuta absoluta*, a new invasive invading India. https://blog.plantwise.org/2015/02/19/tuta-absoluta-a-new-invasive-invading-india/

NHB, 2014. National Horticulture Database 2013.pp.289.

Pereyra, P.C. and Sanchez, N. 2006. Effect of two Solanaceous plants on developmental and population parameters of the tomato leafminer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). *Neotropical Entomology*, **35**: 671-676.

Potting, R. 2009. Pest risk analysis, *Tuta absoluta*, tomato leaf miner moth. Plant protection service of the Netherlands, 24 pp. *Proceedings of National Academy of Science USA*, **96**: 5944-5951.

Sridhar, V., Chakravarthy, A., Asokan, K.R., Vinesh, L.S., Rebijith, K.B. and Vennila, S. 2014. New record of the invasive South American tomato leaf miner, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) in India. *Pest Management in Horticultural Ecosystems*, **20**(2): pp 148-154

Thomas, M. B. 1999. Ecological approaches and the development of .truly integrated. Pest Management.

Urbaneja, A., Vercher, R., Navarro, V., Garcia, M. F. and Porcuna, J. L. 2007. La polilla del tomate, *Tuta absoluta*. *PhytomaEspana*, **194**: 16-23.

Newcastle disease and its pathotypes

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Newcastle disease (ND) is a highly contagious disease with significant global impact on the economy of poultry industry. The disease caused by Avian Avulavirus-1 (AAv1) has been grouped under the *Paramyxoviridae* family. OIE defines ND as "notifiable" if the causative virus has an intra-cerebral pathogenicity index (ICPI) equal to or greater than 0.7 and/or possesses multiple basic amino acids at the C-terminus of the fusion protein cleavage site (FPCS).

Worldwide, the disease outbreak was reported with varied distribution. The disease was first reported in Dutch East Indies (Java- Indonesia) and Newcastle upon Tyne in England. In India, it was first reported in Ranikhet and Chennai city. The disease was reported to be endemic in India with regular reports of disease outbreak, despite regular vaccination programmes. The outbreak could be attributed by several other factors; however, the presence of virus in close proximity would pose a major threat equally to the unvaccinated and vaccinated population. This acquires importance by the fact that feral birds, water fowls and free-roaming local birds were found to be natural reservoirs and asymptomatic carriers of the virulent virus. It was also reported that these natural reservoirs have contributed to the panzootic form of this disease globally.

The disease was diversely reported in various avian species with varied degree of susceptibility. It has so far been reported in 241 species of birds representing 27 of the 50 orders of that class. It was reported in house crows, pigeons, Japanese quails, peacocks and pheasants, guinea fowls, ducks and geese, emus, pet birds, double crested cormortans and spotted-necked dove.

Pathotype and pathogenicity

Many strains of AAv1were reported globally and they were grouped into five pathotypes on the basis of their clinical signs in SPF chickens upon infection. These pathotypes are:

a. Viscerotropicvelogenic - a highly pathogenic form in which haemorrhagic intestinal lesions are frequently seen
b. Neurotropic velogenic - a form that presents with high mortality, usually following respiratory and nervous signs

c. Mesogenic - a form that presents with respiratory signs, occasional nervous signs, but low mortality
d. Lentogenic or respiratory - a form that presents with mild or subclinical respiratory infection, and
e. Asymptomatic - a form that usually consists of a subclinical enteric infection.

Assessment of pathogenicity of AAv1

The designation of AAv1 isolate into the pathotypes described necessitates its assessment by biological methods and molecular techniques.

Biological methods in assessment of AAv1 pathogenicity

The standard conventional parameters used in the assessment of pathogenicity have been reported to be mean death time (MDT), intravenous pathogenicity index (IVPI) and intra cerebral pathogenicity index (ICPI).

1. MDT was assessed in embryonated chicken eggs as the mean time taken by the highest dilution of the virus to cause death of the embryo. The MDT was found to be <60 hours for virulent, 60-90 hours for mesogenic and >90 hours for lentogenic strains.
2. ICPI serves as a definitive assessment of the virulence of the virus. ICPI has been estimated based on the numeric criteria of scoring sick or dead birds (0 = normal; 1 = sick; 3 = dead) after intracerebral inoculation of virus in day old chicks. An ICPI score $\geq$0.7 has been reported to be virulent.
3. IVPI is calculated as mean score per bird over a time period of 10 days after intravenous injection of AAv1. The IVPI values ranged from 1.7-2.8 for velogenic, 0.0 – 8.0 for mesogenic and 0.0 for lentogenic.

Molecular methods for assessment of AAv1 pathogenicity

The molecular techniques have gained importance in the pathotyping of virus due to the rapidity at which it could be demonstrated. The determination of the pathotype of AAv1is on the basis of F gene. It is the determinant factor that ascertains the virulence of the AAv1 strains. The FPCS and its cleavage specificity varies with AAv1 strains. The cleavage site contains specific amino acid sequences. The lentogenic strains possess monobasic amino acid residues at the FPCS region, that gets cleaved exclusively by extracellular proteases. Thus, the tropism of the lentogenic virus is confined to respiratory and enteric tract, where extracellular proteases are abundant. Whereas the mesogenic or velogenic strains possess polybasic amino acid sequences that can be recognized by furin-like proteases, present in most of the cells. This phenomenon depicted the pantropic nature of the velogenic strains in the host.

The deduced amino acid sequences at the cleavage site for the strain with high virulence for chicken has amino acid sequence ^{112} R/K-R-Q-K-R/R ^{116} at the C-terminus of the F_2 protein and F (Phenylalanine) at residue 117 at the N-terminus of the F_1 protein, whereas the virus of low virulence has the sequence in the same region as ^{112} G/E-K/R-Q-G/E ^{116} and 1 (Leucine) at residue 117. This phenomenon has been exploited in partial amplification and detection of F_0 cleavage site in F gene to provide

an insight in the virulence nature and designation of the pathotype by various molecular techniques. However, it the other genes such as HN and L also attributes to the pathogenicity of AAv1.

The use molecular techniques like gel based Reverse Transcriptase Polymerase Chain Reaction (RT-PCR), real time based RT-PCR, nucleotide sequencing and restriction enzyme based procedures facilitate characterization of AAv1. Specific gene-based assays were developed for M-gene, both L-gene and M-gene and F-gene, degenerative primer-based RT-PCR assays, semi-nested RT-PCR amplification of F gene.

The conventional biological methods (MDT and ICPI) were found to have contrary results in a previous study. Moreover, it has also been reported that the pathotyping results obtained by biological methods have not been in correlation with the molecular characterization of F gene. Hence, the essentiality to substantiate the characterisation of the isolatewith both biological and molecular techniques, whenever necessary, has become inevitable.

REFERENCES

Alexander D.J. and D.A. Senne (2008). Newcastle Disease and Other Avian Paramyxoviruses. *In*: A Laboratory Manual for the Isolation, Identification and Characterization of Avian Pathogens, Dufour-Zavala L. (Editor in Chief) Swayne D.E., Glisson J.R., Jackwood M.W., Pearson J.E., Reed W.M, Woolcock P.R., 4th ed., *American Association of Avian Pathologists*, Athens, GA, pp. 135–141.

Collins, M.S., J.B. Bashiruddin and D.J. Alexander (1993). Deduced amino acid sequences at the fusion protein cleavage site of Newcastle disease virus showing variation in antigenicity and pathogenicity. *Arch. Virol*., **128**: 363-370.

Nagai, Y., H.D. Klenk, R. Rott (1976). Proteolytic cleavage of the viral glycoproteins and its significance for the virulence of Newcastle disease virus. *Virology.,***72** (2): 494–508.

Ninth Report of the International Committee on Taxonomy of Viruses: Virus taxonomy: classification and nomenclature of viruses (2012). Eds., A.M.Q King, M.J. Adams, E.B. Carstens and E.J. Lefkowitz. San Diego. Elsevier Academic Press.

OIE (2012). Manual of diagnostic tests and vaccines for terrestrial animals: mammals, birds and bees. In: Biological Standards Commission. World Organization for Animal Health, Paris, pp. 555-573.

Panda, A., Z. Huang, S. Elankumaran, D.D. Rockemann, S.K. Samal (2004). Role of fusion protein cleavage site in the virulence of Newcastle disease virus. *Microb. Pathog*., **36** (1): 1–10.

Romer-Oberdorfer, A., O. Werner, J. Veits, T. Mebatsion, T.C. Mettenleiter (2003).Contribution of the length of the HN protein and the sequence of the F protein cleavage site to Newcastle disease virus pathogenicity. *J. Gen. Virol.,***84** (11): 3121–3129.

Corporate Social Responsibility (CSR) initiatives in Dairy and Animal Husbandry Development

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ABSTRACT

Livestock contributes a major share in the agriculture economy of the country, but unfortunately, low investment and insufficient funding have resulted in underperformance of the sector. Corporate Social Responsibility (CSR) activity is defined as any intervention by a company directed towards community development. Thus, funds available under CSR can be tapped for use in animal husbandry projects through concerted efforts. Furthermore, CSR initiatives can help explore the possibilities of newer and much needed public-private partnerships in livestock development. Most of the livestock development activities under CSR interventions by corporate involve partnerships with NGOs and government bodies. The evidence of several corporate organizations working in the field level has set an example for the elevation of the dairy and livestock sector in our country and thus enhancing the livelihood of small and marginal farmers. Therefore, there is a need for greater resource mobilization from other sources to support the development of animal husbandry in India. Enhancing investments in this sector through CSR funds offer one good opportunity to address this issue.

Keywords: livestock, corporate, sector, animal

INTRODUCTION

The livestock sector can be considered as a future engine of agricultural growth. Unfortunately, low investment and insufficient funding have resulted in the underperformance of the sector. Since government funding for several livestock development schemes remains limited (GOI, 2012), new opportunities need to be explored to meet the requirements. To this end, the recent notable development i.e., Companies Act 2013 could be one important avenue (CII, 2013). A Corporate Social

"Businesses need to go beyond the interests of their companies to the communities they serve."

– Ratan Tata (Former Chairman of the Tata Group)

Responsibility (CSR) activity is defined as any intervention by a company directed towards community development (NFCG, 2013). CSR endeavours of companies range from livelihood promotion, health, environment, education, rural infrastructure and women's empowerment (Hussain, 2014). Despite the fact that India possesses vast livestock resources (512.05 million), besides 729.2 million poultry, a sizeable proportion of livestock suffer from poor production and productivity (GOI, 2014). The average milk productivity, for instance, hovers around 2.5 kg/day for indigenous cows, 4.91 kg/day for buffalo, 6.78 kg/ day for crossbred cows and 0.45kg/day for goat (DAHD&F, 2015). The productivity is thus far less than the average daily yield of cattle in the developed nations. Furthermore, average meat yields in different species remain abysmally low. The meat yield of most species in India is 20-60% lower than that of the world average. The Animal Husbandry sector receives 12 percent of the total public expenditure on agriculture and the allied sector (GOI, 2012), resulting in the underperformance of the sector. Hence, it is clear that government funding in this sector remains limited. There is a need for greater resource mobilization from other sources to support the development of animal husbandry in India. Enhancing investments in this sector through CSR funds offer one good opportunity to address this issue. Moreover, the Government of India has already emphasized the public-private partnership in livestock extension services (GOI, 2012). The Government has suggested making concerted efforts to tap funds available under CSR for implementing animal husbandry projects (GOI, 2015).

Corporate Social Responsibility (CSR)

The concept of Corporate Social Responsibility (CSR) has emerged from philanthropic activities (charities and donations) of corporations. CSR can be defined as the continuing commitment by businesses to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large (WBCSD, 2015). A CSR activity is defined as any intervention by a company directed towards community development (NFCG, 2013). CSR in India has gone beyond mere philanthropy and it has a more

strategic role in the overall organizational development (Gupta and Kaur, 2013). By incorporating CSR in their business portfolio, companies have made significant achievements in areas such as education, healthcare, livelihoods, rural development and urban development (NFCG, 2013). As per the Indian Companies Act 2013, it is mandatory for certain classes of enterprises to spend 2 percent of their profit to social development activities such as education, health, agriculture, animal husbandry and rural livelihood generation (CII, 2013).

CSR interventions in dairying and animal husbandry development in India

Most of the livestock development activities under CSR interventions by corporates involve partnerships with NGOs and government bodies. For instance, BAIF is one prominent NGO working for livestock development by fostering partnerships with several corporates across states of Maharashtra, Madhya Pradesh, Andhra Pradesh, Rajasthan, Gujarat, Karnataka, Bihar and Uttar Pradesh (BAIF, 2015). Such linkages and partnerships through CSR activities also help corporates in enhancing the relationship with stakeholders such as customers, regulatory authorities, local communities and NGOs (Lojpur and Draskovic, 2013). Some of the prominent agro-based organizations that have undertaken livestock development as a CSR activity are Nestle, ITC, Chambal Fertilizers, Indian Immunologicals (IIL), Godrej and Rashtriya Chemicals and Fertilizers. In addition, many other corporates such as Tata Chemicals, Ambuja Cement Foundation, Bharat Petroleum, Raymond India have also involved themselves in the CSR activities focusing on animal husbandry. Animal health through animal health camps, animal sterility camps, vaccination and deworming camps are the most common activities organized under CSR interventions. Some of the corporates appreciably have also made efforts on enhancing the capacities of livestock owners.

Fig 1. Some of the prominent organizations that have undertaken livestock and dairy development as a CSR activity

Challenges in using CSR funds in dairying and animal husbandry development

The Companies Act 2013 specifies the list of activities under Schedule VII, which can be included by the companies in their CSR policies. The list of activities, however, seems to be heavily skewed towards health and education. These sectors are already high priority sectors for government funding. Agriculture development *per se* does not find a mention in the list of activities included in the Companies Act (2013). Animal Welfare has been grouped with activities like ensuring environmental sustainability, ecological balance, protection of flora and fauna, agro-forestry, conservation of natural resources and maintaining quality of soil, air and water, including contribution to the Clean Ganga Fund setup by the Central Government for rejuvenation of river Ganga. Apparently, CSR activities for animal husbandry under the new Companies Act have received minimal attention as necessary elaborations on the livestock development are currently unavailable. Further, meaningful co-ordination between several animal husbandry organisations with dairy organisations and people's organisations remains absent (Hegde, 2012). Due to lack of co-ordination among state animal husbandry departments, dairy cooperatives and NGOs, duplication of livestock development efforts may happen through CSR activities especially in the matter of routine delivery of services by livestock development agencies.

WAY FORWARD

1. Prioritizing CSR activities on animal husbandry

CSR funding can potentially add resources to an otherwise financially neglected animal husbandry sector. Some of the areas that deserve attention are as follows: feed and fodder research and development, *Gosadhan* and *Gaushala* development, expansion of cold chain infrastructure for milk collection, setting up of abattoirs, small ruminant development, managing government livestock farms, strengthening of extension educational infrastructure as well as increasing the livestock insurance coverage. In some instances, the companies can also provide human resource and expertise, such as in managing Government livestock and poultry farms, formation and functioning of dairy self-help groups, microfinance support for livestock based livelihood activities, value chain development and market linkages.

2. Sensitization of government machinery towards public private partnership through CSR

Much of the CSR interventions in livestock development are delivered through partnerships of corporates and NGOs. The State Agricultural Universities and animal husbandry departments possess large amount of trained technical staff and infrastructure to carry out livestock development activities. CSR gives a good opportunity for these institutions to foster institutional pluralism and public private partnership. However, often government animal husbandry institutions work with hierarchical approach and the institutions are reluctant to accept such innovations.

Hence, there is an urgent need to sensitize and create awareness among the authorities about the potential importance and the role of CSR for overall livestock development. This not only improves the delivery of services but also minimizes the chances of redundant activities and red tape.

3. Long term approach for animal husbandry development

Often the private extension efforts are profit oriented and short term. These endeavours are concentrated on big farmers, more accessible regions and specific livestock species to earn maximum effort. Privatization may hamper free flow of information and create more inequalities among livestock owners. Also, eco-friendly and sustainable farming practices are not favored. The same can occur with the CSR interventions as well. The support of veterinary institutions to CSR in livestock development at present is limited to the sporadic delivery of technical services initiated by private agencies. The government veterinary institutions and private companies need to work for long term holistic livestock development through CSR. Most of the current activities are limited to organizing animal health camps and distribution of free medicines and health additives only.

4. Effective Monitoring and Evaluation of CSR activities

Though some of the past CSR initiatives are commendable, yet one cannot deny the fact that companies also perform these activities to build their reputation as well as business expansion. This may also be the case for NGOs who often seek funds on the basis of credibility and reputation. Therefore, these organisations may misrepresent and exaggerate their CSR efforts. Appropriate independent agency must monitor the funds utilized as well activities performed. Impact analysis of livestock development is a specialized job and often has to be undertaken after providing sufficient time.

CONCLUSION

Looking at the bright prospects of dairying and livestock sector to further enhance its contribution to National GDP, it is imperative that more funds should flow in this sector. But this seems not likely from the conventional funding sources. The CSR interventions under the Companies Act 2013, therefore, may be seen as one good opportunity to be cashed upon to fund developmental activities in livestock sector. This, however, calls for better coordination among different agencies viz. State Departments of Animal Husbandry, cooperatives and NGOs involved in livestock sector to make good use of the available funds. We are of the firm view that the CSR funds can strengthen the livestock sector.

REFERENCES

BAIF (2015). http://www.baif.org.in/programmes_under_csr.asp (Accessed on 19.10.2019)

CII (2013). Handbook on Corporate Social Responsibility in India. Pricewater Coopers Private Limited (PwCPL), Gurgaon, India

DAHD&F (2015). Annual Report, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India,New Delhi.

GOI (2012). Report of the Working Group on Animal Husbandry and Dairying. 12th Five year plan, 2012-2017. Planning Commission, New Delhi.

GOI (2015). Proc. National Workshop on strengthening Small Ruminant Based Livelihoods, January 16-17,Department of Animal Husbandry and Dairying and Fisheries, Ministry of Agriculture and South Asia Pro Poor Livestock Policy Programme(SAPPLPP), New Delhi

Gupta, G. and Kaur, S. (2013). Sustainable Development-Through Corporate Social Responsibility (CSR) in Times of Economic Slowdown. *Siddhant-A Journal of Decision Making*, *13*(3), 203-209.

Hegde N.G. (2012). Dairy Extension for Transfer of Technologies. Souvenir. Indian Dairying: Perspective 2020. XL Dairy Industry Conference. Feb. 2-5. Indian Dairy Association, New Delhi. 75-80.

Hussain, S (2014). Corporate social responsibility: initiatives and its impacts on socio-economic development on rural areas of India. *Asian Journal of Multidisciplinary Studies*, *2*(4).

Lojpur, A. and Draskovic, V. (2013). The institutional context of corporate governance and corporate social responsibility. *Montenegrin Journal of Economics Vol. 9, N0 1 2*.

NFCG (2013). Study of Impact of CSR activities of companies working in collaboration with public agencies ,A study by National Foundation for Corporate Governance & ITC Centre of Excellence for Sustainable Development CII,New Delhi, India

WBCSD (2015). http://www.wbcsd.org/work-program/business-role/previous-work/corporate-social-responsibility.aspx

Dairy Cooperatives in India: An Overall Outlook

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ABSTRACT

India presently, with its largest network of Dairy Cooperative Structure in the world, stands world leader in milk production with more than 21 per cent of the world's share. Milk being the essential dietary nutrition to a large number of people thus has a huge market demand for milk and milk products. Dairy cooperatives play an important role in the procurement, processing and marketing of milk and milk products. It pools the vast diversity of dairy farmers to sell their produce at the fair price, thereby enriching their life socially, economically and politically. Further, farmers' participation in dairy co-operatives has resulted in a significant increase in milk production and productivity and has reduced per-unit cost of milk production thereby enabling them to achieve higher output prices, reduced transaction costs and increased profits. Even though today, India has stood self-sufficient in milk production, but milk production throughout the states in India is not uniformly distributed due to various socio-economic, institutional and marketing constraints and therefore, there are huge demand and supply gap of milk and milk products. Dairy cooperatives in this direction, thus play a crucial role in bridging the gap and enhancement of milk production and productivity if the country in a holistic manner.

Keywords: Dairy, cooperative, milk

INTRODUCTION

India is the world's largest producer of milk, with 21 percent of global production. As, a global leader in milk production, the total bovine population in India is estimated at 299.60 million, out of which cattle are 190.90 million and buffalo is 108.70 million (Livestock Census 2012, DAHD&F).In India, the share of agriculture and allied sector in gross value addition (GVA) is 17.5 per cent and livestock sector share in GVA is 4.5 per cent (National Account Statistics, 2017), thus providing livelihood opportunity to 70 million households. Much of the success of the 'White Revolution' in India is attributed to the co-operative framework of dairy development strategies. India with the world's largest Dairy Cooperative structure, at present, constitutes 163 lakh dairy farmer members, 1.77 lakh village dairy cooperative societies, 218 district milk cooperative Union and 27 State Milk Federations registered under National Dairy Development

Board. Milk is one of the major outputs of the dairy sector and most of the milk in the country is being produced by small and marginal farmers coupled with landless labourers. India now attained the status of the world's largest milk producing nation with an annual production of 187.7 million tones and subsequently the per capita availability of milk hovers around 394 gms/day (NDDB, 2019-20). The annual growth rate in milk has been estimated at 6.50 per cent. The per capita monthly expenditure on milk and milk products is increasing both in rural (116.38) and urban areas (187.14) (NSSO, 2012). In India, dairying has broader social and economic dimensions, wherein about 70 million rural households are engaged in dairying and contributes 26% income of the poorest households and 12% of rural income (NDDB, 2017-18). Currently, 48% of total milk produced is either consumed at producer level or sold to non-producers in rural areas and 52% of milk is marketable surplus for sale to consumers in urban centres, of which 40% of milk sold is handled by organized sector including DCs and producer companies (20%) and private dairies (19%) and the rest by unorganized sector. Within the organized sector, the co-operative sector is by far the largest in terms of volumes of milk handled. It is planned to increase the marketable surplus of milk to 60% by 2021-22, which is mainly to be handled by organized sector to improve livelihoods and economic well-being of milk producers as a part of doubling farmer's income by 2022 (GoI, 2018).

BRIEF GENESIS OF DAIRY COOPERATIVES IN INDIA

Dairy cooperatives first originated in Gujarat and spread throughout the country with the implementation of Operation Flood (OF) program. A Success story on the Dairy scene in India during the sixties was the farmer-owned AMUL Co-operative in Anand (Kaira District, Gujarat) with is integrated approach to Production, Procurement, Processing and Marketing on Co-operative line. Amul was spearheaded by Tribhuvandas Patel under the guidance of Sardar Vallabhbhai Patel. The year,1964 was the turning point in the history of dairy development programme in India when, Late Shri Lal Bahadur Shastri, the then Prime Minister of India who visited Anand on 31s October for inauguration of Amul's Cattle Feed Plant, having spent a night with farmers of Kaira and experiencing the success wished and expressed to Dr. Verghese Kurien, the then General Manager of Amul that replicating Amul model throughout our country will bring a great change in the socio-economic conditions of the people. In order to bring this dream into reality, 1965 The National Dairy Development Board (NDDB) was established at Anand and by 1969-70 NDDB came out with the dairy development programme for India popularly known as "Operation Flood" or "White Revolution". The Operation Flood programme, even today, stands to be the largest dairy development programme ever drawn in the world. This saw Amul as model and this model is often referred in the history of White Revolution as "Anand Pattern". Replication of "Anand Pattern" has helped India to emerge as the largest milk producing nation in the world.

THREE TIER STRUCTURE OF MILK COOPERATIVES

Village Society: A Dairy Cooperative Society (DCS) is the grass root/village level cooperative institution where members supply their surplus milk and buy the various services provided by the cooperative. Any producer can become a DCS member by buying a share and committing to sell milk only to society. Each DCS has a milk collection centre where members take milk every day. Each member's milk is tested for quality with payments based on the percentage of fat and SNF. At the end of each year, a portion of the DCS profits is used to pay each member a patronage bonus based on the quantity of milk poured.

The District Union : A Cooperative Union is the district level institution formed by the union of village-level Dairy cooperative Societies for the purpose of collection, processing, marketing of milk and organizing services for the benefit of members. It is expected that: Most Unions also provide a range of inputs and services to DCSs and their members: feed, veterinary care, artificial insemination to sustain the growth of milk production and the cooperatives' business. Union staff train and provide consulting services to support DCS leaders and staff.

The State Federation: The cooperative milk producers' unions in a State form, a State Federation, which is responsible for marketing the fluid milk and products of member unions. Some federations also manufacture feed and support other union activities.

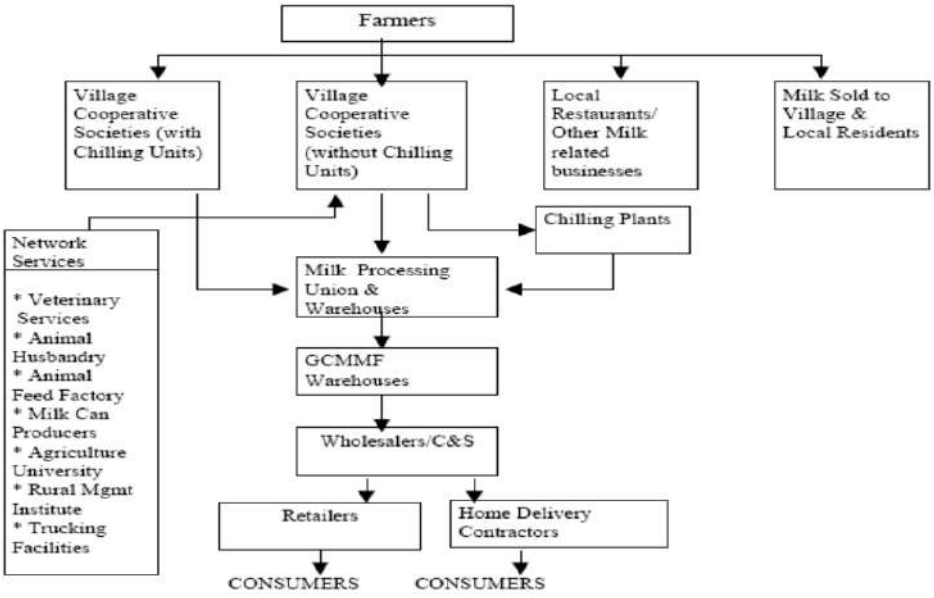


Fig 1. Basic Supply Chain Model of a Dairy Cooperative (eg. Amul Model)

PROSPECTS OF DAIRY COOPERATIVES

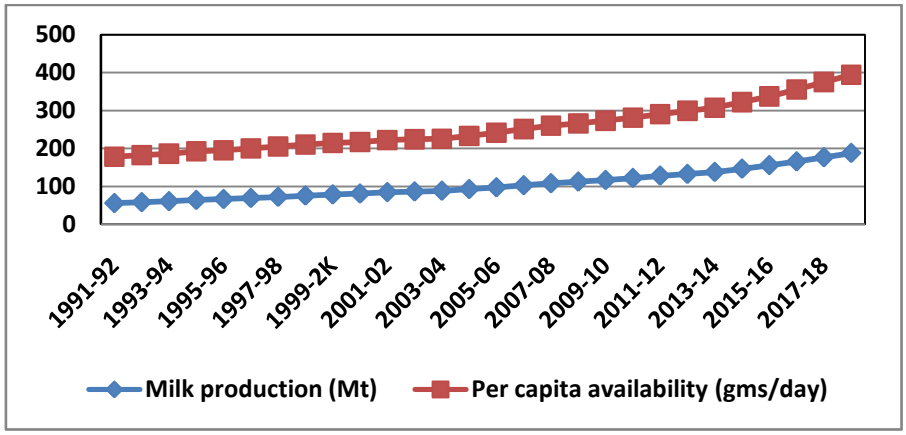
Dairy development in India has been acclaimed as one of the most successful development programmes in the world. The functioning of the dairy co-operatives is based on collective action, which is supposed to be inclusive and participatory. It is

assumed for assisting smallholders' engagement in milk markets, contributing to the improvement in production and productivity, and finally enhancing the farmers' income and welfare. Several studies have shown that integration with co-operatives have benefited the farmers and indeed have served as a catalyst for linking Indian dairy smallholders to the markets–domestic as well as global markets. Dairy farming involves high market dependency and socio-economic values, wherein Dairy Cooperatives help dairy farmers to vertically integrate to countervail power against oligopolistic powers in distribution and retailing, by organizing dairy supply chains with better strategic logistics between production, processing and distribution in emerging markets and reducing financial risk and economic uncertainty faced by dairy farmer members in a market due to increasing volatility in milk and feed prices and therefore; paying dairy farmers the milk price at levels that far exceeds market prices.

CHALLENGES OF DAIRY COOPERATIVES

The dairy sector is characterized by small-scale, scattered, and unorganized milk-animal holders; low productivity; inadequate and inappropriate animal feeding and health care; lack of an assured year-round remunerative producer price for milk; an inadequate basic infrastructure for provision of production inputs and services; an inadequate basic infrastructure for procurement, transportation, processing and marketing of milk; and lack of professional management. Other important characteristics of the dairy sector are the predominance of mixed crop-livestock farms and the fact that most of the milk animals are fed on crop by-products and residues, which have very low opportunity costs. Additionally, the dairy-development policies and programs that are followed, including those relating to foreign trade, are not congenial to the promotion of sustainable and equitable dairy development. Involvement of intermediaries; lack of bargaining power by the producers; and lack of infrastructure facilities for collection, storage, transportation, and processing are the major problems that affect the prices received by producers in milk marketing. Milk quality assurance, value addition, infrastructure support development, and global marketing are also found to be the future challenges of India's milk marketing.

Fig 2. Milk production and Productivity of India (1991-2019 Data)



Source: Basic Animal Husbandry Statistics, DAHD&F, GoI

Table 1. Dairy Development Status of India (2017-18 Data)

Sl. No.	Parameter		Quantity
1.	Milk Production – 2017-18 (in 000 tonnes)		176347.35
2.	Per Capita Availability – 2017-18 (in gram/day)		375
3.	Total Number of Villages (2011 Census)		640932
4.	No. of Milk Potential Villages (% of total no. of villages)		319556 (49.86%)
5.	Number of organized Dairy Cooperative Societies (DCS)		185903
6.	No. of Milch Animal owning Households (MAH) (in Lakh)		691
7.	Number of Farmer members enrolled under DCS		16574445
8.	Average Milk Procurement by DCS (in TKgPD) (% of Milk Production)		47563 (9.84%)
9.	Chilling Centres	Number	507
		Capacity (TLPD)	18044
10.	Bulk Milk Cooler (BMC)	Number	14027
		Capacity (TLPD)	37659
11.	Processing Plants	Number	332
		Capacity (TLPD)	73344

Source: GoI (2019). Bimonthly Report, September, 2019. State Dairy Profiles, Dairy Development Schemes. Department of Animal Husbandry and Dairying. Ministry of Fisheries, Animal Husbandry and Dairying, Govt. of India

Government of India is making efforts for strengthening infrastructure for production of quality milk, procurement, processing and marketing of milk and milk products through following Dairy Development Schemes:

- National Programme for Dairy Development (NPDD)
- National Dairy Plan (Phase-I)
- Dairy Entrepreneurship Development Scheme (DEDS)
- Dairy Processing and Infrastructure Development Fund (DIDF)

CONCLUSION

Dairy cooperatives in India play an important role in the production, processing and marketing of milk and milk products, thereby helping dairy farmers earn remunerative prices for their produce and enhancing their socio, economic and political life. In this era of Globalization and liberalization when operational boundaries have reduced and socio-economic, cultural restrictions relaxed, institution-building focuses on enabling a dairy cooperative to become a viable, self-reliant, dynamic, truly member-owned and controlled enterprise. The cooperative approach thus attempts to assist dairy cooperatives to strengthen their business through better governance, improved operational efficiencies, professional approach towards management and performance, while striving to bring about its self-sustaining all-round improvement over the long term.

REFERENCES

DAHD&F (Department of Animal Husbandry, Dairy and Fisheries) (2018-2019). http://www.dahd.nic.in/about-us/divisions/cattle-and-dairy-development. Retrieved on 16 January 2020.

GoI (2018).National Action Plan for Dairy Development (NAPDD), Vision-2022. Department of Animal Husbandry and Dairying and Fisheries. Ministry of Agriculture and Farmers Welfare,GOI.

Livestock Census (2012). 19th Livestock Census, Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture. http://www.dahd.nic.in/documents/statistics/livestock-census. Retrieved on 13 January 2020.

NAS (National Account Statistics) 2017. Ministry of Statistics and Program Implementation GOI. (2017) www.mospi.gov.in. Retrieved on 18 January 2020.

NDDB (2018-19). Annual Report 2017-18. National Dairy Development Board, India.

NDDB. (2017-18). Annual Report 2017-18. National Dairy Development Board, India.

NSSO (National Sample Survey Office). Ministry of Statistics and Program Implementation.68th round 2011-2012). www.indianstatistics.org. Retrieved on 17 January 2020

Septic arthritis and its clinical approaches in cattle

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ABSTRACT

One of the common problems encountered by an Indian animal farmer is mostly the lameness of cattle which could be highly attributed to septic arthritis which can lead to economic loss.Lameness due to joint infection is the second common cause next to lameness due to digit abnormalities or infections. Septic arthritis is the most common infection of synovial structures in cattle, followed by infection of tendon sheaths and synovial bursae.It is caused by the invasion of microorganisms into synovial space. Infection of the joint can be through different ways. Animals are mostly depressed and or presented with acute non–weight-bearing lameness, joint swelling, pain and heat on joint palpation and with or without fever. Early diagnosis is essential for successful treatment of septic arthritis.This article is intended to give a brief outline of septic arthritis and its clinical approaches.

Keywords: cattle, septic arthritis, infection

ETIOLOGY OF SEPTIC ARTHRITIS

Infection of the joint mostly develops through several possible routes, haematogenous route was found to be the most common commonly presented (navel ill in calves) or by indirect infection from a focus nearby or by direct infection through trauma or through arthrocentesis which was found to be the least common.Umbilicusis a verycommon route of infection in young calves. Inadequate hygiene and disinfection of the umbilicus afterbirth and failure of transfer of passive immunity are the most important factors contributingto umbilical infectionIn adult cattle the hematogenous spread is mostly seen in diseases originating in the postpartum period such as lacerations after forced extraction, retained placenta, endometritis, mastitis, and endocarditis (Margarette*et al.,* 2007).

Several organisms were found to be the cause of septic arthritis such as Mycoplasma, *Lactococcus lactis*(Wichtel*et al.,* 2003),Chlamydophila(Twomey, 2003), *Salmonella typhimurium* (Blake *et al.,* 1997)*Erysipelothrix*species (Dreyfuss*et al.*, 1990) and *Streptococcus dysgalactiae*(Ryan *et al.*, 1991).

After the infectious agent enters the synovial space, a severe inflammatory response develops. Bacteria can damage the cartilage or the synovial membrane directly and alter the character of the synovial fluid. Even sometimes severe immunological host response is seen. Inadequatenutrition and enzymatic degradationleads to articularcartilage degeneration resulting in break-down products, which in turn cause synovitis of the particular joint(Van pelt, 1968).

Clinical signs

Septic arthritis is usually characterized by important clinical signs such as severe lameness, distention of the joint, pain on palpation and during passive motion of the affected joint. The animal may or may not have fever and appears dull and appear depressed. Usually only one joint is infected but in calves polyarthritis is seen more commonly than in adult cattle (Rohde*et al.*, 2000).

DIAGNOSIS

The first basic thing in diagnoses is to observe the animal's stance and the posture. Compare the affected limb to the normal limb to determine obvious swelling, wounds, shifting ofweight, and foot posture, such as toe touching or favoured weight bearing on the medialor lateral claw. A combination of clinical findings, radiographic examination, synovial fluid analysis and microbial culture results are necessary to establish a diagnosis (O'Callaghan, 2002).

Radiographic findingsshowssoft tissue swelling, gas accumulation in the joint, widening of the joint space in acute condition or narrowing of the joint space because of articular destruction. Sometimes bony lesions such as osteolytic changes are seen if the infection is persistent for 10 to14days.

Arthrocentesis should be carried out for macroscopic and microscopic evaluation of the synovial fluid and bacterial culture. Macroscopic evaluation of the synovial fluid shows higher volume, reduced viscosity, changed colour (yellow, reddish, brown), turbidity, fibrin, and abnormal odour.Other parameters that are analysed are White blood cell count (WBC), percentages of neutrophils (PMN), total protein (TP) concentration and specific gravity. TP concentration > 4.5 g/dl, WBC ≥ 25'000 cells/µl, percentage of PMN≥ 80% indicate septic arthritis. (Rohde*et al.*, 2003). The simultaneous use of different culture mediums helps in confirming the infective organism and in choosing the right antibiotic for the treatment. Ultrasound can also be used for diagnosis and is superior to radiography for evaluation of soft tissues (Kofler, 1996).

TREATMENT

The ideal treatment of synovial infection should be focussed on control the infection, removal of bacteria, removal of abnormal joint fluid , control inflammation and restoration of joint function(Nuss, 2011). Surgical removal of an infected umbilicus should be carried out in case of young calves.

In cases that are diagnosed early, parenteral antibiotic therapy can be very effective, bringing about a complete resolution of the joint damage and a return to normal function. Cephalosporins, ampicillin or penicillin in combination gentamicin are a good

choice. IV or IM administration should be preferred to reach higher local minimal inhibitory concentration levels. Systemic antibiotics should be administered for 2-3 weeks after improvement of clinical signs(Nuss, 2011).

Joint lavage is a simple and effective treatment in cases, which have failed to respond to parenteral antibiotic therapy and in animals which would otherwise become permanently crippled. It is an easy to carry out procedure which can be done under general or local anaesthesia. NSAID'S such as Flunixin meglumine (dose of 2.2 mg/kg) and Ketoprofen (3 mg/kg) can be used for effective pain control for a period of two to three days(Jackson, 1999), which reduces the inflammatory response and increases the comfort of the patient. Arthroscopy and arthrotomy are the preferred techniques of treatment in very severe cases.

REFERENCES

Blake N, Scott PR, Munroe GA (1997). Septic physitis, arthritis and osteomyelitis probably caused by *Salmonella typhimurium* DT104 in beef suckler calves. *Cattle Pract.,*5(4):345–6.

Dreyfuss DJ, Stephens PR (1990).*Erysipelothrixrhusiopathiae*– induced septic arthritis in a calf. *J Am Vet Med Assoc*., 197(10):1361–2.

Kofler J: Arthrosonography - the use of diagnostic ultrasound in septic and traumatic arthritis in cattle - a retrospective study of 25 patients. *Brit Vet J.,* 152:683-698, 1996

Margaretten ME, Kohlwes J, Moore D, *et al*. (2007) Does this adult patient have septic arthritis? *JAMA*, 297(13):1478–88.

Nuss, K (2011). Synovial structures - cure or no cure? In: SIVAR International Congress, Cremona, Italy,39-40.

O'Callaghan KA (2002). Lameness in cattle and associated pain in cattle - challenging traditional perceptions. *In Practice,* 24:212-219.

Rohde C, Anderson DE, Desrochers A. (2000) Synovial fluid analysis in cattle: a review of 130 cases. *Vet Surg.,* 29:341-346.

Ryan DP, Rothwell JT, Hornitzky MA (1991). *Streptococcus dysgalactiae* infection in calves. *Aust Vet J.,*68(6):210.

Twomey DF, Griffiths PC, Hignett BC(2003). Suspected chlamydial polyarthritis in a calf in the UK. London: *Brit Vet Assoc.*

Van Pelt RW, Langham RF (1968). Synovial fluid changes produced by infectious arthritis in cattle. *Am J Vet Res*, 29(3):507–16.

Wichtel ME, Fenwick SG, Hunter J (2003). Septicaemia and septic arthritis in a neonatal calf caused by Lactococcus lactis. *Vet Rec.,* 153(1):22–3.

History and Importance of Equines in Indian Agrarian Sector

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Abstract
Equines have belonged to *Equidae* family that includes asses, horses and zebras. In the Indian agricultural sector *Equidae* family has not been given much importance that results intodecreases in population. In India,since antiquitythe historical references about horses are available, which indicating their presence in Indian subcontinent. The seven equines breed are distributed in India. The use of equines in war and the racing industry is well proven. Considering the important utilities of equines,there is great scope for the growth of the equine industry.

Key Words: *Equidae*, Equines, literature, racing, utility.

INTRODUCTION

Equines belong to*Equidae* family that includes asses, horses and zebras. The total population of *Equidae* in the country is 0.55 Million (DAHD, 2019). As compared to previous (2012) livestock census, the population of horses, donkeys and ponies has decreased by 51.9%.Majority of horsesand Poniesare concentrated in Uttar Pradesh (0.76) (Million), mules in Uttarakhand (0.26) and, donkeys in Rajasthan (0.23).In Indian agricultural perspective,equine are given less importance and isnot much organizedexcept in the racing industry.

Equines History- World

The evolution of the horse began around 65 million years ago nearsteppe lands north of the Black Sea from Ukraine to Kazakhstan. Domestic horses*E. caballus* (2n = 64), weredomesticated in many places across Europe and Asia around 6000 years ago (Olsen, 1988 andGoodwin, 2007).

Equines History- India

Traditionally, in India horses are used for transportation, war, riding chariot and race. Ancient Indian literature recorded that Usha and Agni ride on horse chariot.There is mention of "Ucchasrava"a seven-headed flying horse (Aswa/Asva)recovered in Samudramanthan belonging to god Indra. The legendary historical war of Ramayana and Mahabharata mentioned the use of horses in transportation and war. The Ashwamedha Yagna is a ritual where kings let theirhorses travelthe territories of enemies and it was considered that those enemies who allow the horse to passthrough their territories are ready to accept the kingship of this king.

"Shalihotra"the first known veterinarian of the world was an expert in horse husbandry. Salihotra's Asvayurveda Siddhanta considered as the complete Ayurvedic system for horses whilehis other two books written on horses includes Asva-lakanasastra and Asva-prasamsa. Moreover, Nakula of Mahabharta wrote Ashvacikitsita, another horse specialist of India (Somvanshi, 2006). The Kautilya's Arthashastra incorporated the administration of royal stables and the care of horses. Source ofthe Kautilya Arthasastra, Punjab, Sind, and Saurashtra regions were those who sustained stable horse populations and breeding.

Archaeologically, there are reports of the evacuation of horse'sremnants from Harappan and Mohenjodaro civilization with clay models of horses. Paintings of Bhimbetka caves in Madhya Pradesh also have drawings of horses.

Horses were named or recognized as per their origin or the mode of transportation they undertook. Horses driven overland from their native habitats in Central Asia or the eastern Himalayas were referred to in medieval Arabic and Persian sources as *barri* or "horses from the land," while those shipped by sea were *bahri* (Arabic) or *daryai*(Persian)(Anjum, 2012 and Lambourn, 2015).

Indian Equines Breeds

As of now, as per the ICAR- National Bureau of Animal Genetic Resources (NBAGR) there are seven breeds of horses found in India, *viz.,* Marwari, Kathiawari, Manipuri, Zanskari, Bhutia, Spiti andKachchhi-Sindhi. Except for Marwari and Kathiawari, remaining breeds are called ponies due to their small size that does not let them fit into the definition of a horse.

Uses of Equines

Equines play an important role in the agriculture sector in hill and terrains. Equine breeding for the sport and race purpose is highly successful enterprise(Kelekna, 2009 and Liljenstolpe, 2009).

Racing and Sport: The major chunk of income for equine owners is from the equine racing industry. The horses are used in sport mainly polo, chariot racing and other local games.

Transportation: In the growing trend of urbanization,use of the horse for transportation purpose is diminished, but nowadays it is gaining importance because, it is being considered as a sign of prestige mainly attracting rich peoples from metro cities.

Pack animal in hilly area: In the hilly area, the horses and ponies are used as pack animals. Once animals are trained and get acquainted with the route then they will follow the track and deliver the goods to respective locations.Mules,cross of male donkey and mare are specially used for this purpose as they inherit the endurance, stamina and brain from both that makes mules multipurpose animals.

Tourism: In the tourism industry, horses playsvery important role as they are used for chariot driving as well as carrying tourist from remote locations,that attracts the tourist.

Agriculture fieldwork: Especially, in hilly terrain ponies are used for field works. They are also used as draft animals for ploughing.

Defence: Horses and ponies areproved to be very useful on the battlefield during ancient days. Nowadays, they are indirectly playing an important role in warfare *viz*. transporting food and artilleries to the military in desert and mountain areas. For instance, they have proven their importance in Kargil war.Mounted police are using the horses for security and watch purpose. Recently, Mumbai police has decided to introduce mounted police cops.

Equines appendages: Equine industry byproducts are also useful due to their high market value. This includes hairs,used for preparing paintbrushes,crafts, making jewellery items *i.e*. bracelets, necklaces, earrings and barrettes. Horsehide/leather is use for the preparation of shoes, bags and clothing which have high demand and market value.

Medical field: in the medical field, they are used for harvesting sera for treatment of snake bites.

CONCLUSION

Since the ancient days equines have been proventheir usefulness to human in day to day life. They arealso very good companion animals. In the field of livestock sector, there is great demand of proven breeds of equines for sport and racing purpose. The entrepreneur wants to start a business in equine industry havegoodopportunities in breeding,equine feed, veterinary and health care services, equipment and training for sport.

REFERENCES

20th Livestock Census**,** Department of Animal Husbandry and Dairying (DAHD) 2019. http://164.100.117.97/WriteReadData/userfiles/key%20results.pdf.

Anjum, N.A., (2012). January. Horse Trade in Medieval South India. In Proceedings of the Indian History Congress, 73: 295-303.

Goodwin, D., 2007. Horse behaviour: evolution, domestication and feralisation. In The welfare of horses (pp. 1-18). Springer, Dordrecht.

Kelekna, P., (2009). The horse in human history, pp. 175-184. Cambridge: Cambridge University Press.

Lambourn, E., (2015). Towards a Connected History of Equine Cultures in South Asia: Bahrī (Sea) Horses and "Horsemania" in Thirteenth-Century South India. Medieval Globe: 57.

Liljenstolpe, C., 2009. Horses in Europe. EU Equus, 32.

Olsen, S.J., (1988). The horse in ancient China and its cultural influence in some other areas. Proceedings of the Academy of Natural Sciences of Philadelphia: 151-189.

Somvanshi, R., (2006). Veterinary medicine and animal keeping in ancient India. *Asian Agri-History*, *10*(2), pp.133-146.

Allele Mining: An Approach for Crop Improvement

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The world allele emanated from Greek word allelos means each other'. Alleles are alternative DNA sequences at the same physical locus, which may or may not result in different phenotypic traits. Mining meaning searching some things. Thus allele mining means searching for different alleles or finding of superior allele from the natural/mutated population. The chief objective of allele mining is to detect allelic variation of particular trait among germplasm collection in other word it is the process to identify the new superior alleles for various traits like disease resistance, drought tolerance, quality etc. These alleles can be used in breeding programmes to enhance yield and quality parameter as well as improve resistance against biotic and abiotic stress in different crops. Notwithstanding collection of large number of germplasm lines, the available genetic variation has not been explored and utilized efficiently; still there is enough scope to identify large number of superior alleles.

Allele mining can be efficiently utilized to tap the potential genetic diversity. A true allele mining involves the consideration of variations in both expressed as well as non-expressed regions of the gene. It includes 5'UTR, promoter, introns, exons, 3'UTR, splice sites, etc (Fig. 1). There are so many examples available to articulate that intronic mutations plays vital role in the creation of allelic diversity which have probable role to modify the phenotype. In recent times sequence variation in the regulatory regions of the gene is gaining more importance as it directly involved in gene expression.

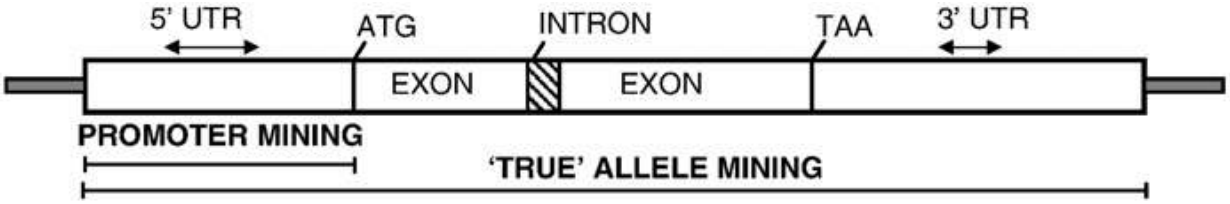

Figure 1: "True" allele mining of a gene

PRE-REQUISITES FOR ALLELE MINING

The essential tools required for allele mining are,

1. Large number of diverse genotypes,
2. Gene and genome sequencing information,
3. Efficient phenol-typing techniques,

4. Cost effective genome sequencing techniques.
5. Bioinformatics tools,
6. Relevant software to analyze the data, etc.

Approaches in allele mining

Most commonly used approaches are TILLING, Eco TILLING and Sequence based allele mining. TILLING (Targeting Induced Local Lesions IN Genome) is one of the reverse genetics approaches where mutations are induced and useful mutations are detected. It is a technique that can identify polymorphisms (more specifically point mutations) resulting from induced mutations in a target gene by heteroduplex analysis (Till *et al.,* 2003). Thus TILLING is nothing but a technique to determine variation in individual through artificially changed mutation. The use of the Tilling technique to survey natural variation is called Eco-TILLING. Eco-TILLING is essentially like the TILLING except that it does not involve artificial induction of mutations; rather it detects the natural point mutations available in the primary and secondary crop gene pools. The sequence based allele mining involves the DNA sequencing and searching for nucleotide variation between diverse genotypes. It involves amplification of alleles in diverse genotypes through PCR followed by identification of nucleotide variation by DNA sequencing techniques. It is very accurate and easy method but it is costly as compared to other methods. However, advanced next generation sequencing methods may considerably reduce the sequencing cost and made this method more affordable.

Tools required for allele mining

Software tools are useful for handling the complex nucleotide data, prediction of functional or structural components of complex macromolecules, prediction of transcription factor binding sites, identification of sequence polymorphisms and to predict the amino acid changes which are responsible for changes in encoded protein structure and function. Allele mining requires various sophisticated bioinformatic tools viz., PLACE, plantCARE, TRANSFAC, JASPAR, MEME, Plantprom DB, DCPD, SCPD, BioEdit, ClustalW etc.,. These tools useful for sequence alignment means to compare our genome sequence to reference genome i.e, sequenced genome data.

Applications of allele mining

Allele mining can be effectively used for gene prediction, expression study, evolutionary study, discovery of superior alleles, identification of new haplotypes, similarity analysis-inter and intra species and functional molecular marker development for MAS. It has diverse applications in the field of crop improvement like;

1. Discovery of superior alleles and characterization of allelic diversity among the germplasm and minimize the load of maintaining germplasm.
2. It used in identification of new haplotypes.
3. Understanding the molecular basis of trait variation and to detect sequence variations associated with superior alleles and development of allele-specific markers for Marker Assisted Selection.
4. Allelic synteny and evolutionary relationship can be studied.

5. Assessing the genetic worthiness of accessions for target trait improvement.
6. It can also provide insight into molecular basis of novel trait variations and identify the nucleotide sequence changes associated with superior alleles.

In concise allele Mining is a reverse genetic approach that is used to dissect naturally occurring allelic variations or suitable alleles of a candidate gene controlling key agronomic traits which has potential in crop improvement. **It** plays an important role in realizing the worth of the plant genetic resources (PGR). Conservation and proper utilization of the PGR may lead to a breakthrough in addressing present-day challenges like climate change, appearance of diseases, regular drought, flood etc. innovation and exploitation of better alleles through allele mining for disease resistance, drought tolerance etc. may contribute significantly to secure the future food basket.

MAGIC populations in crop improvement

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Conventional breeding has played a major role in identification of prominent and superior varieties and germplasm with novel characters and develop high yielding varieties with better agronomic traits in the earlier years. But with time environment has also changed. Environmental stress due to its biotic and abiotic factors has become a major concern for today's breeders. Scientists have developed different molecular biology techniques to assist and improve the breeding procedure and reduce time to get the superior genetic stocks with final yield and other advantageous agronomic traits. A crucial step towards enhancing the productivity of food crops entails rapid identification of genes and their utilization in plant breeding to pro-vide better control and delivery of agronomic traits. Traditional approach for identification of such genetic elements based on biparental mapping populations is found to have some drawbacks. Many problems associated with biparental mapping populations are low allele diversity; low level recombination events; creation of narrow genetic base in the newly developed breeding lines which leads to vulnerability to different pest and diseases as well as abiotoc stresses. Further, identifying genes that have minor effects on quantitative character is trickier. In order to address these problems, multiparent-based mapping populations have been formed and widely studied for diverse quantitative traits in different crops and indicated superior performance of MAGIC-derived lines over biparental derived lines.

Multi-parent Advanced Generation Inter-Cross (MAGIC) populations are an emerging type of resource for dissecting the genetic structure of traits and improving breeding populations. They developed by inter-crossing multiple parental lines in a balanced funnel crossing scheme. Parental lines may be inbred lines, clones or individuals selected on the basis of their origin or use. The resulting RILs are highly recombined mosaics of the founder genomes. They mix well-characterized founder genomes in controlled pedigrees, and facilitate the investigation of both the genome itself and its relationship with traits and the environment. According to Darvasi and soller (1995) MAGIC population is a simple extension of the advanced intercross. The method was first proposed and applied in mice by Mott et al. (2000). MAGIC term coined by Mackay and Powell (2008) and advocated by them. It involves inter-mating multiple elite parents for several cycles followed by single-seed descent (SSD), resulting

in recombinant inbred lines (RILs) that each carry a mosaic of genome blocks contributed by all founders. It described as "heterogeneous stock". It allocates the recognition of genes controlling quantitative traits, by crossing diverse combinations of various parents. MAGIC lines occupy an intermediate position between naturally occurring accessions and existing synthetic populations." MAGIC population were first developed and described in Arabidopsis and later it has been undertaken in a few other crops also, including, wheat, barley, maize, sorghum, rice and chickpea.

OBJECTIVES OF MAGIC POPULATION

- MAGIC has the potential to increase the speed and efficiency of breeding.
- MAGIC will direct impact on the production of farms as well as the ability to change the way of scientists to identify the genes that control the quality and disease resistance.
- MAGIC populations served as source material for extraction and development of breeding lines and varieties.
- Development of variety with several agronomical beneficial traits and such varieties can be adapt to several diverse regions and suitable for diverse climatic conditions.

STEPS INVOLVE IN DEVELOPMENT OF MAGIC POPULATION

- **Founder selection**: Founder selections are made on the basis of genetic or phenotypic diversity, either in a elite cultivars, geographical adaptation, land raced or from worldwide germplasm collections and distant relatives. Use of landraces as founders may introduce greater diversity. Narrow genetic diversity can be problematic for estimating founder probabilities and prevent researchers from fully exploiting the potential of their populations. Ultimately the selection of the founders is one of the most important steps and depends heavily on the goals of the breeder. More diverse founder sets may provide biological insight into a wide variety of traits.
- **Mixing of parents**: Mixing of parents together in predefined patterns and inter-mated. The inbred founders are paired and inter-mated known as funnel. The result of this stage is a set of lines whose genomes comprised contribute from each of founder.
- **Advanced intercrossing:** Cross between two inbred lines. Each generation intercross sequentially and randomly. Selection is phenotypic to further reduce the frequency of deleterious allele from the donor. Mixed lines from different funnels are randomly and sequentially intercrossed as in the advanced intercross. The main goal is to increase the number of recombinations in a population. Minimum six cycles of intercrossing is necessary for huge perfection in QTL mapping.
- **Inbreeding:** It is essential for development of homozygous individuals. For this selfing of individuals either directly from funnels or after advanced intercrossing to form inbred lines. RILs in plants can be created via single seed descent or

doubled haploid production. Doubled haploid production is often faster. The several generations of selfing will bring in additional recombination.

ADVANTAGES OF MAGIC POPULATION:

1. Through MAGIC population new genetic combination are created from the re-shuffling of the starting varieties.
2. Best combinations of genes for different important characters are developed through MAGIC population
3. Used for extraction of good combination and directly released as a variety of best population.
4. It permits a more precise identification of genes that are responsible for superior quality traits.
5. New form s of allelic variability is identified or discovered through MAGIC population.
6. Recombinations are increased through multi-parent advanced generation inter-crosses.
7. Scientist are able to more precisely identify the genes of important traits because large number of individuals and the product of numerous generations of inter-crossing of parents involved in the development of MAGIC population.

LIMITATIONS OF MAGIC POPULATION:

1. Large scale phenotyping is required
2. It required more time and input.
3. Some times incompatibility is presents in the parents involve in development of MAGIC population.
4. Better marker system is necessary to identify QTLs.

Buzzbox- A Wireless Sensor Network (Wsn) Technology for Precision Apiculture

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Abstract

The current environmental ramifications due to industrial agriculture, climatic change and pathogens have destructed the habitat and loss of biodiversity. These ecological modifications have threatened the apiculture including the bees and wild pollinators which plays a vital role and indispensable in the terrestrial ecosystems. This application presents the foundational space of apiculture, challenges, and emerging techniques of the apiarists in beekeeping including precision apiculture, and a low-cost IoT and remote sensing technology deployed for data gathering and monitoring the vigour and productivity of beehive colonies. This system will complement the urgent need to countervail the honeybee colonies' collapse by helping the apiarists, apiculture subsector, and agriculture sector to embark emerging precision apiculture technologies.

INTRODUCTION

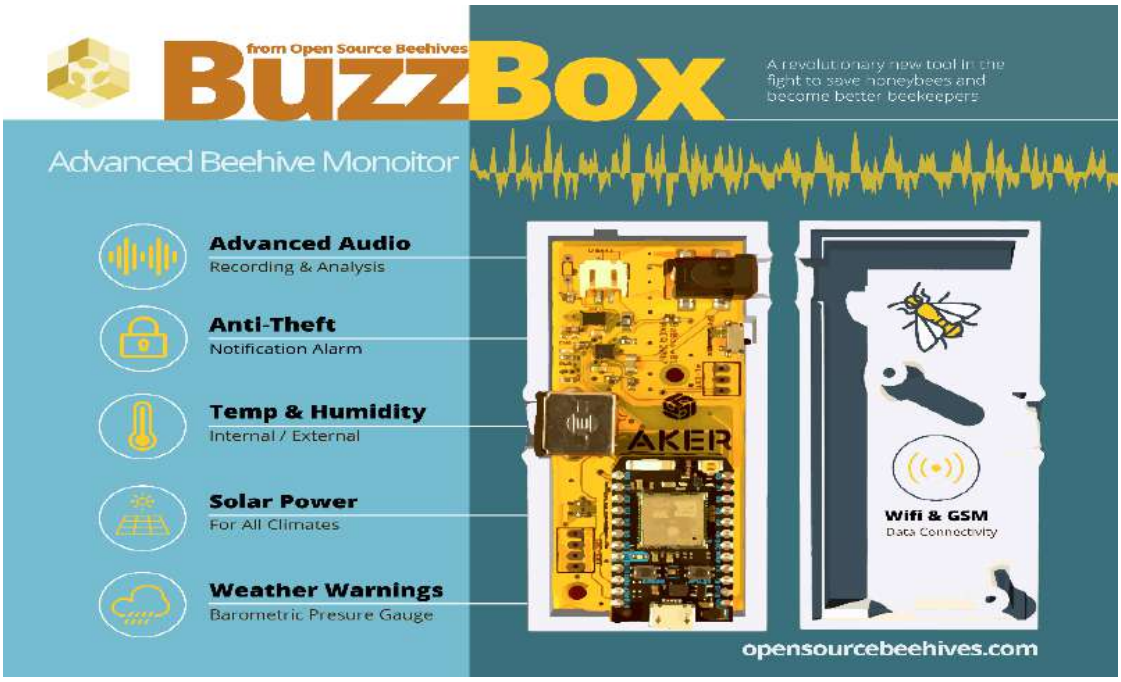
Internet of things (IoT) has allowed countless sectors and companies to boost effectiveness through the implementation of centralized surveillance solutions for the most significant procedures over the previous few years. In apiculture or beekeeping, one such instance can be discovered. Buzz- box is a smart application for accuracy apiculture, it enables apiarists to control beehives for many potential purposes as mentioned in several studies, data analytics and best practices on beekeepers' real-time monitoring of bees and learning how to reduce the resources and time allocated in beekeeping activities without compromising the quality and productivity of honeys.

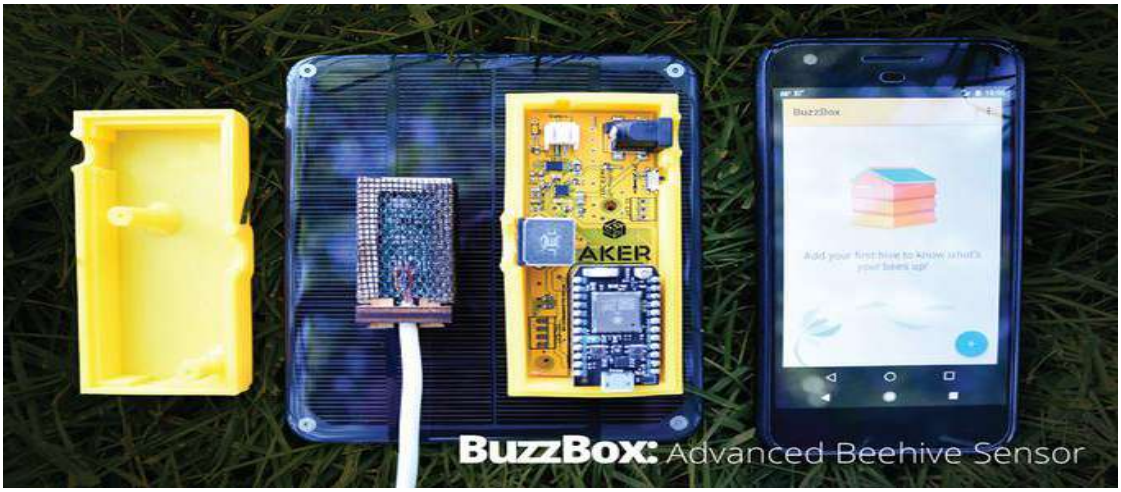
Buzz-box

A wireless sensor system for Internet surveillance of beehive microclimate variables, including temperature, relative humidity, and weight that could enhance techniques of apicultural research and development invented by John Minchin and Copley Smith.

Key Features

- Honey Bee Health Monitor: automatic hive health updates via real-time colony audio analysis
- Track your bees from your smartphone (Android and iOS)
- Receive smartphone security alerts to prevent theft or invasion
- Monitor internal and external temperature and humidity, barometric pressure
- Solar powered and fully energy neutral
- Weather-resistant enclosure for all shipped kits
- Transmits data via WiFi (WiFi connection required for v1.0/GSM is in development for v2.0)
- Over-the-air updates for new, free product features





The following key obstacles will be found out by the sensors in beehive.

- Empty/Collapsed
- Active/Normal
- Pre-Swarm/Swarm
- Missing Queen

CONCLUSION

Precision beekeeping is still evolving but, wireless beehive system allows apiarists to monitor the temperature, relative humidity, and weight monitoring non-intrusively, hence, it promotes beehives to become healthy and increase honey's productivity, and effectively perform the overall aspects of apiary management using the Buzz-box web/mobile application.

Zinc: a nutritive element and its microbial solubilization

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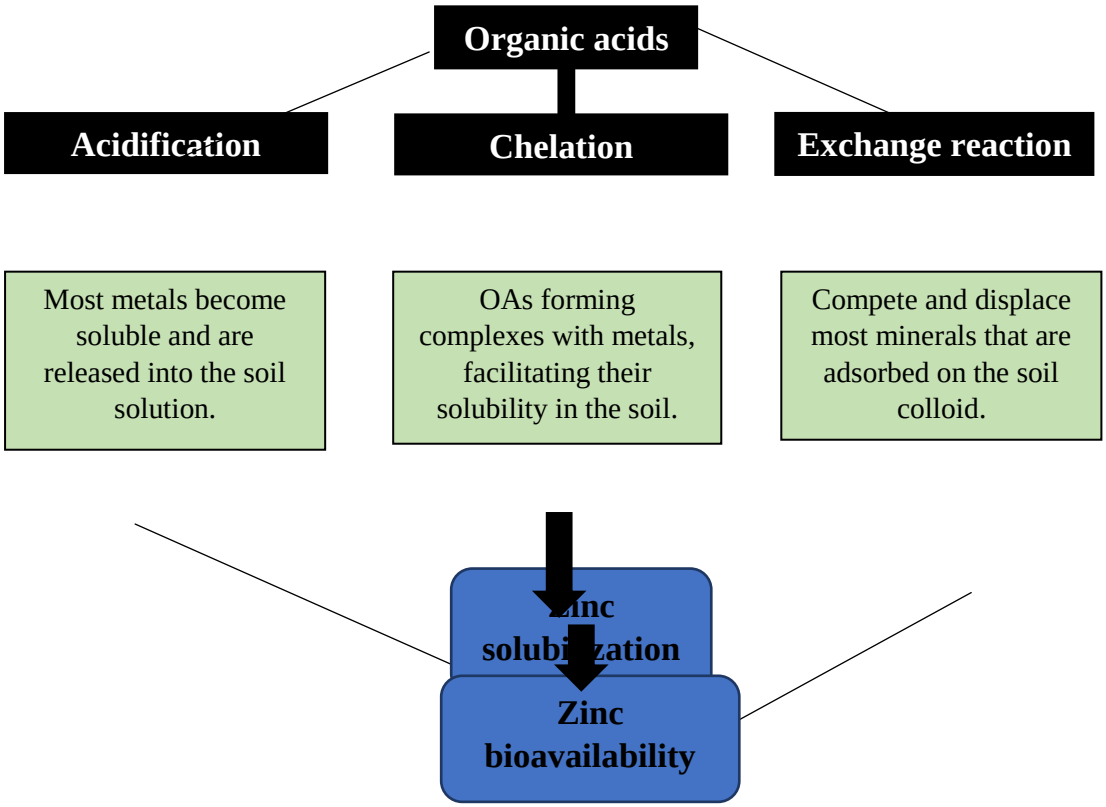
Zinc (Zn), cationic micronutrient, deficiency reported as the fifth major health risk issue in animalsand plants worldwide. As we know, India is the 7th largest country and 3rd most populated nation in the world where people of societiesmostly consume cereals and pulses for their energy and minerals sources. With poor nutritive value of Znin cereals and pulse grains, zinc deficiency causes malnutrition in infants which are future of our nation. Lesser availability of zinc is associated with several soil factors like high pH, high contents of calcium carbonate, high concentrations of bicarbonate ions and high levels of available phosphorus. Although, Zn containing synthetic fertilizers or organic manures are crucial to enhance the available Zn pool in the soil. Butunfortunately, high proportion (96.0–99.0%) of appliedzinc fertilizers again converted to unavailable by precipitation to carbonates or oxides or phosphates etc. (Zhang *et al.,* 2017). A beneficial alternative is use of zinc solubilizing microorganism alone or in combination with chemical fertilizers. These organisms are able to transform insoluble zinc compound to soluble forms and make it available for plant assimilation.zinc solubilizing rhizobacteria actively participate inroot colonization and produced low molecular weight organic acids that exerts beneficial effect on plant growth. The zinc solubilizers acidify the rhizosphere and make available insoluble metals or they form chelates with metals to enhance their solubility in soil solution. They promote plant growth by producing hormone like Indole acetic acid (IAA) and help in root colonization thus provide greater surface area contact to trap nutrients. Several, *in vitro* studies were done in order to identify the species which are able to solubilize zinc and have been reported like *Acinetobacter, Bacillus, Burkholderia, Gluconacetobacter, Pseudomonas, Thiobacillus* (Vidyashree*et al.* 2016).

MECHANISM OF ZINC SOLUBILIZATION-

Production of low molecular weight organic acid-

1. Most organic acids in soil system are produced by plant, microorganisms and through organic matter decomposition. Plant origin organic acids are mainly constituents of plant root exudates.

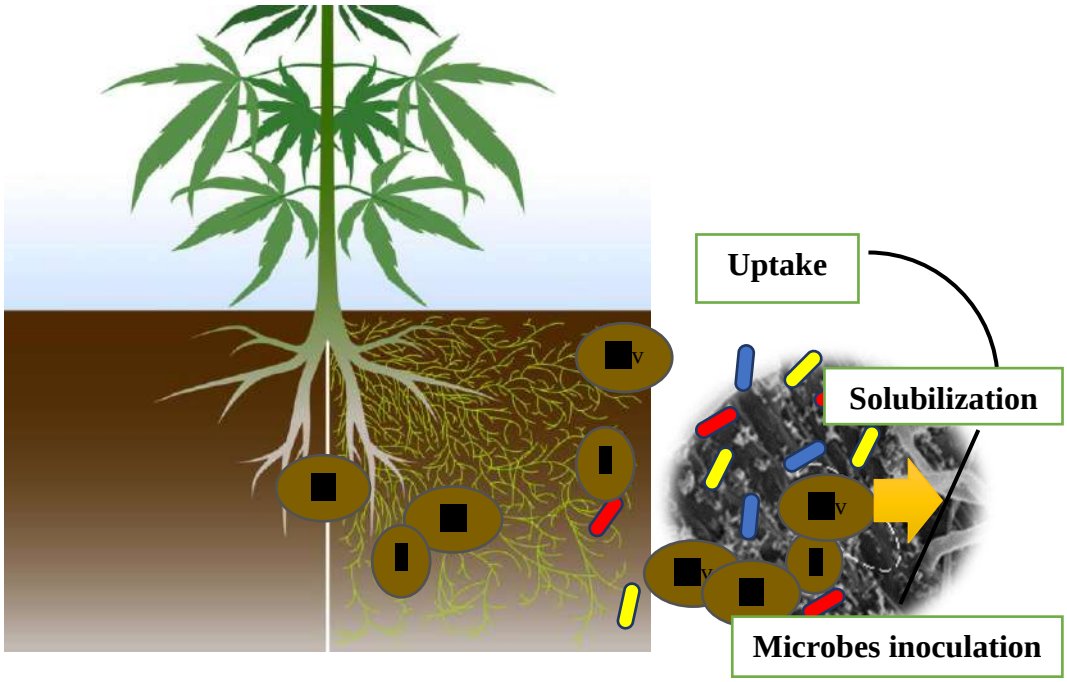
2. Soil microorganisms such as bacteria and fungi produce and releases several organic acids to solubilize relatively insoluble elements like P, Zn and Fe in the soil and enhance their availability.
3. low molecular weight Organic Acids (LMWOAs) are low in molecular weight which varied between 46 DA to a few 100 DA.
4. Generally,gluconic acid and its derivative 2-ketogluconic acid produced by zinc solubilizing bacteria and fungiis augmenting the dissolution of insoluble Zn compounds through reductions in the pH of the medium.
5. Several other organic acids also released by bacteria and fungi lactic, isovaleric, isobutyric and acetic acids glycolic, oxalic, malonicand succinic acids.
6. Chelation is the dominant phenomena to improve Zn bioavailability and uptakeby plant roots through microorganisms. This mechanism is used bybacteria, e.g., *Pseudomonas monteilii*, *Microbacteriumsaperdae*, and *Enterobacter*cancerogenesis the manufacture of Zn-chelating metallophores for enhancing watersoluble Zn in soil for plant uptake (Whiting *et al.*2001)



Changes in Root Morphology-

1. Zinc is immobile nutrient in soil and is taken up by plants specifically by diffusion. Zinc bioavailability can be increased either by more Zn application or improving root growth and surface area. Zinc solubilizing microorganism have ability toincrease the surface area of root which helps to uptake zinc from long distance.

2. Production of phytohormone like IAA stimulate the plant cell division, extension, and differentiation, increases the rate of xylem and root development and initiates lateral and adventitious root formation. Moreover, produced IAA increases overall root surface area and length, and thereby provides the plant root greater access to soil nutrients that are very less in soil solution.



METHOD OF APPLICATION:

Judicious application of fertilizer Zn helps increasecrop production as well as it helps enrichment ofZn in plant organs including grains. Use of microbial consortia with inorganicwatersoluble zinc fertilizers is a good approach to enhance the zinc content of food grains. Application of zinc sulphate heptahydrate ($ZnSO_4.7H_2O$) @ 12.5 kg/ha with seedling root dippingor/and seed inoculation is advantageous for crops.Split application of zinc sulphate is better than just single basal dose.

REFERENCES

Whiting, S.N., Souza, M.D., Terry, N. (2001)Rhizosphere bacteria mobilize Zn for hyper accumulator by *Thlaspicaerulescens*. *Environment Science Technology.***35**:3144–3150.

Vidyashree, D.N., Muthuraju, R., Panneerselvam, P., Saritha, B., Ganeshamurthy, A.N. (2016) Isolation and characterization of zinc solubilizing bacteria from stone quarrydust powder. International Journal of Agri. Sciences.**8**: 3078–3081.

Zhang, X., Jiang, B., and MA, Y. (2017) Aging of Zn added to soils with a wide range of different properties: Factors and Modeling. *Environmental Toxicology and Chemistry*, Vol. **36**, No. 11, pp. 2925–2933, 2017

Sub-Surface Drip Irrigation (SSDI) Lateral Depth, Emitter Spacing and Discharge Rate

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ABSTRACT

The effect of lateral depth, emitter spacing and discharge rate was reviewed as a function of the performance of subsurface drip irrigation system. Yield response for over 30 crops indicated that crop yield for subsurface drip irrigation was greater than or equal to that for other irrigation methods, including surface drip irrigation and required less water in most cases. The lateral depth should be sufficient to avoid damage from tillage or other equipment but shallow enough to wet the root zone without wetting the soil surface, except where necessary for seed germination. The present review revealed that placing lateral line at the depth of 20-40cm is most suitable for different crops. As a general rule, emitter spacing is usually related to the plant spacing within the row, emitter spacing of 30 cm is opted for most of the field crops. Increasing the discharge rate generally results in an increase in the wetted soil diameter and a decrease in the wetted depth hence discharge rate of less than 2lph is suitable for good wetting pattern.

Key words: *Lateral Depth, Emitter Spacing, Discharge rate, Soil Wetting Pattern*

OPTIMUM DEPTH FOR PLACEMENT OF LATERAL

Required depth of water is influenced by depth of the lateral beneath the soil. Evaporation decreased with increasing drip line depth and evapotranspiration in drip irrigation could be reduced to 40% when the drip line is buried at a depth of 15 cm compared with surface drip line (El-Awady*et al.,* 2003)

In SSDI, top 20 cm of soil have lower soil water content when laterals are buried at 45 cm soil depth, resulting in reduced evaporation. SSDI is also not exposed to sun and extreme weather condition ensuring a longer life of the system. Drip line depths ranging from 20 to 60cm were found to be acceptable for corn production with no

significant differences in water productivity (WP) and only slight reductions in corn grain yield for the deeper 40 and 60cm drip line depths (Lamm and Trooien, 2007).

OPTIMUM EMITTER SPACING

Increasing the emitter spacing can provide several advantages: (1) to allow larger emitter passageways less subject to clogging; (2) to allow for economical use of more expensive emitters, and (3) to allow longer length of run or increased zone size by decreasing the drip line nominal flow rate per unit of length (Lamm and Camp, 2007).

However, excessive emitter spacing must be avoided in order to prevent inadequate water distribution within the root zone. Another disadvantage of increased emitter spacing is the compounding of the water redistribution problem when emitters become clogged and the result is inadequately irrigated plants (Lamm and Camp, 2007). The design process should carefully match emitter discharge and emitter spacing to the soil hydraulic characteristics in order to avoid problems such as backpressure and water surfacing that can occur with improper design. These problems can reduce irrigation uniformity (Lazarovitch*et al.,* 2005) and can exacerbate soil water redistribution problems (Battam*et al.,* 2002).

OPTIMUM DISCHARGE RATE

Drip irrigation systems generally consist of emitters that have discharge varying from 2.0 to 8.0 lph. In semi-arid climates, crop water use during summer can be 6 to 8 mm day^{-1}, with water supplied two or three times a week. Even if the water is supplied on a daily basis, a water application rate of 2.0 lph provides the consumptive need of the plant in a small fraction of the period over which photosynthesis and transpiration occur. This means that even for water application exactly equal to the plant water need, part of the water may not be used by the plant and would most likely drain below the root zone. Therefore, lowering the emitter discharge to as close as possible to the plant water uptake rate may improve irrigation efficiency.

Micro drip irrigation systems will provide emitter discharges of 0.5 lph. These systems have been studied most intensively in greenhouses and the results showed that they reduced water consumption of tomato plant by 38%, increased yield by 14 to 26%, and reduced leaching fraction by 10 to 40%. In sweet corn under field conditions, Assouline *et al.* (2002) have shown that micro drip irrigation may improve yield, reduce drainage flux, and affect the water content distribution within the root zone, especially through an increased drying of the 60 to 90 cm soil layer compared with conventional drip irrigation.

Increasing the emission rate generally results in an increase in the wetted soil diameter and a decrease in the wetted depth.

CONCLUSION

A comprehensive approach on lateral depth, emitter spacing and discharge rate are required for different soil types and cropping systems to ensure better water management practices which in turn increases crop production.

REFERENCE

Assouline, S., S. Cohen, D. Meerbach, T. Harodi, and M. Rosner. 2002. Microdrip irrigation of field crops: Effect on yield, water uptake, and drainage in sweet corn. Soil Sci. Soc.Am. J. 66:228–235.

Battam, M., S. Robinson, and B. Sutton. 2002. Water surfacing from subsurface drip emitters. In Proc. Irrig. Assoc. Australia, 277-281. Hornsby, Australia: Irrigation Australia.

El-Awady, M.N; M.F.Abd-Elsalam; M.M.El-Nawawy and M.A.El- Farrah. 2003. Surface and subsurface irrigation effects on spinach and sorghum. The 11th Annual Conf. of Misr Soc. of Agric.Eng., 118- 130.

Lamm, F. R., and C. R. Camp. 2007. Chapt. 13: Subsurface drip irrigation. In Micro-irrigation for Crop Production: Design, Operation and Management, 473-551. F. R. Lamm, J. E. Ayars, and F. S. Nakayama, eds. Amsterdam, The Netherlands: Elsevier Publications

Lazarovitch, N., J. Simunek, and U. Shani. 2005. System dependent boundary condition for water flow from subsurface source. Soil Sci. Soc. America J. 69(1): 46-50

Rumen protected choline-A vitamin: saviour for pregnant cows

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An ancient Chinese curse states, in effect, "May you always live in interesting times." In this context, the transition period between late pregnancy and early lactation (also called the periparturient period) surely is the most interesting time of the lactation cycle. The transition period, roughly stretching from 3 weeks before to 3 weeks after parturition, is a difficult period for high-yielding dairy cows, and is characterized by a high incidence of metabolic, infectious, and reproductive disorders. During early lactation, the energy requirement for milk production and maintenance of a dairy cow exceed the available energy from feed intake. The net shortage in energy resulting from the imbalance between energy input and energy output is called Negative Energy balance (NEB). Due to a severe negative energy balance (NEB) the liver experiences pronounced metabolic stress due to a marked influx of non-esterified fatty acids (NEFA), which are mobilized from adipose tissue. A large part of the whole-body NEFA flux is taken up into the liver and exceeds its oxidation capacity and, thus, promotes the development of fatty liver and ketosis. So supplementation of antioxidant with anti-inflammatory action, with basal feed formulation might reduce the stress of liver in transition cows.

Choline, the beta-hydroxyethyltrimethylammonium ion, is a strong base containing trimethylated quaternary nitrogen. Choline occurs widely in biological materials as the compound itself, as acetylcholine and as various phospholipids. Choline is often considered as a B-complex vitamin; however, like all other classical vitamins, it cannot be synthesized endogenously. Unlike other water soluble vitamins, deficiency of choline in healthy animals is rare because of its interrelation with methionine, folic acid and vitamin. But, physiological conditions like pregnancy and lactation demands more choline. It is also found that, requirement of choline in the diet of animals is much more than the vitamins (g vs. mg). Another important aspect about choline is that, there is rapid degradation of dietary choline in the rumen. So, it must be provided in the protected form.

RPC IMPROVESMILK YIELD AND COMPOSITION

Methionine and lysine are the two most limiting amino acids for milk production in dairy cattle (NRC, 2001). The demand for choline as a methyl donor is probably the main factor determining how rapidly choline deficiency induces a disease state. Therefore, supplementation of choline could spare a portion of methionine needed to meet daily choline needs, which would leave a larger supply of methionine for milk production. It is reported that RPC supplementation tended to increase milk yields in early lactation, while significantly improving milk production when supplemented in mid lactation.The effect of RPC supplementation on milk fat have also been variable.Piepenbrink and Overton (2003) and Pinotti*et al*. (2003), respectively, reported 8.2% and 20.0% improvement in fat yield in the RPC-supplemented group.

RPC IMPROVES DRY MATTER INTAKE (DMI)

Previously reported that, there is a decrease of about 30 percent in DMI during the transition period. After 3 weeks of calving, DMI increases at the rate of 1.5 to 2.5 kg per week and this increase is more rapid in multiparous cows than primiparous cows. The reason behind decrease in DMI during pre-partum period is growing foetal size occupying abdominal space and displacing rumen volume.Responses in DMI with the feeding of RPC have been variable.Many researches have reported (Chung *et al.,* 2005) marked increase in DMI in RPC supplemented cows during transition phase.The mechanism by which choline might influence DMI is not understood, but it is plausible to speculate an indirect effect mediated by improved post parturient health.

RPC reduces the risk of reproductive disorders

It is reported that feeding RPC reduced the incidence of clinical ketosis, mastitis, and morbidity, and the number of cases of mastitis per cow. Also there is significant decrease in open days and services per conception and increase in numbers of pregnant cows when cattle were supplemented with 60 g RPC/ day (Ardalan*et al.* 2009).

RPC reduces fatty liver condition in pregnant cows

Feeding rumen-protected choline contributes towards decrease of plasma concentrations of nonesterified fatty acids (NEFAs) in transition dairy cows. The reduced plasma concentrations of NEFAs associated with the improved hepatic export of triacylglycerol resulted in less hepatic fat concentration and reduced risk of fatty liver and metabolic disorders (Zom*et al*., 2011). Choline acts as a lipotropic factor and helps in improving fat metabolism for better energy production.

RPC improvesimmune status of pregnant cows

During transition period when there is reduction in energy balance, plasma concentrations of antioxidants such as β–carotene, vitamins A (retinol) and E (α-tocopherol) also decrease. As these compounds have a profound role in immune function, low concentrations of these vitamins induces disease condition and reduced

fertility in dairy cows. Very few studies have been reported till yet, regarding the effect of RPC on immune function of transition dairy cows. Sheikh *et al.* (2014) supplemented (RPC 60, g/d) to transition KF cows for 70 days and found a significant increase in total immunoglobulin status in cows.

CONCLUSION

RPC can besupplemented @50-60g/day for 30 days before calving up to 60 days after parturition. Supplementation of RPC will result in enhanced milk production and have a positive and desirable effect on milk quality with increased milk fat content.The improvement in immune status along with alleviation of oxidative stress by RPC might help the transition animals to face the critical challenges during their transition period.

REFERENCE

Ardalan, M., Rezayazdi, K. and Dehghan-Banadaky. (2009). Investigation on the effect of supplementing rumen protected form of methionine and choline on health situation and reproductive performance of Holstein dairy cows. *Pakistan J. Biological sci*., **12**: 69-73.

Chung, Y. H., Cassidy, T. W., Girard, I. D., Cavassini, P. and Varga, G. A. (2005). Effects of rumen protected choline and dry propylene glycol on feed intake and blood metabolites of Holstein dairy cows. *J. Dairy Sci*., **88** (1): 61.

NRC, (2001). National Research Council. Nutrient requirements of dairy cattle. 7th ed.Natl. Acad. Sci., Washington, DC.

Piepenbrink, M. S. and Overton, T. R. (2003). Liver metabolism and production of cows fed increasing amounts of rumen-protected choline during the periparturient period. *J. Dairy Sci*., **86**: 1722-1733.

Pinotti, L., Baldi, A., Politis, I., Rebucci, R., Sangalli, L. and Dell'Orto, V. (2003). Rumen protected choline administration to transition cows: effects on milk production and vitamin E status. *J. Vet. Med*., **50**: 18–21.

Sheikh, F. A., Kewalramani, N., Thakur, S. S. and Mir, I. A. (2014). Effect of supplementation of rumen protected methionine-lysine and choline on milk production in crossbred cows. *Indian J. Anim. Nutr.,* **31**(2): 148-151.

Zom, R.L.G., van Baal, J., Goselink, R. M. A., Bakker, J. A., de Veth, M. J. and van Vuuren, A. M. (2011). Effect of rumen-protected choline on performance, blood metabolites and hepatic triacylglycerols of periparturient dairy cattle. *J. Dairy Sci*., **94**: 4016-4027.