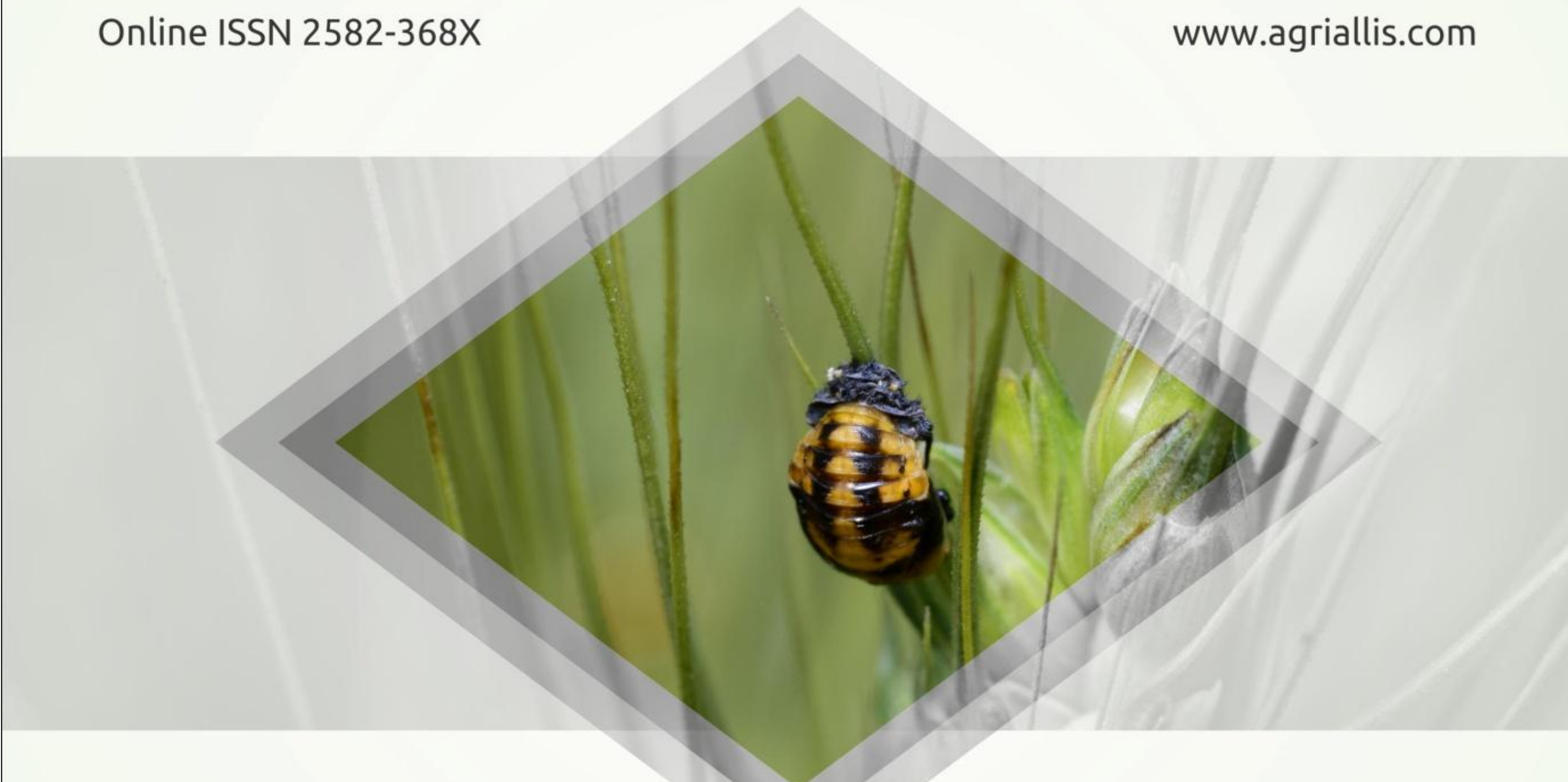
AGRIALLIS

Science for Agriculture and Allied Sector

A Monthly e Newsletter

Online ISSN 2582-368X

www.agriallis.com



Volume 2, Issue 4
April. 2020

Growing seed

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Editorial Board

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Contents

Sl No	Title	Article Id	Page No
1	Impacts of Climate Change Towards The Soil Health. (Soil Physical, Chemical and Biological Properties)	AL202055	1
2	Efficacy of Different Companion Crops to Debar Arthropod Pests in Brinjal Ecosystem.	AL202056	7
3	Socio-Economic Status and Constraints of Weavers in Sital Pati Production in Cooch Behar District of West Bengal.	AL202057	13
4	Smart Sulphur Management for Increased Productivity and Quality of Indian Mustard (*Brassica juncea* L.).	AL202058	19
5	Vesicular Arbuscular Mycorrhizae (Vam): A Sustainable Approach for Soil Phosphorus and Rain-Harvested Water Economy Management In Acid Soils Of Western Himalayan Soil.	AL202059	25
6	Role of Post Harvest Technology in Organic Based Horticultural Farming.	AL202060	31

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

IMPACTS OF CLIMATE CHANGE TOWARDS THE SOIL HEALTH (Soil Physical, Chemical and Biological Properties)

Article Id: AL202055

Abhishek Sen[1*] and Bratati Kanjilal[2]

[1]Department of Soil Science and Agricultural Chemistry, U.B.K.V, Pundibari, Cooch Behar West Bengal

[2]Department of Agronomy, U.B.K.V, Pundibari, Cooch Behar, West Bengal

Email: connectabhishek1@gmail.com

When we are starting to talk about soil health, it is not just a single property of soil. It includes the holistic property of soil which are soil physical, chemical and biological properties the most prominent features towards the sustainable soil health. The most recent report of the Intergovernmental Panel on Climate Change (IPCC) visualised that the average global temperature will probably rise between 1.1 and 6.4°C by 2090 – 2099, as compared to 1980–1999 temperatures, with the most likely rise being between 1.8 and 4.0°C (IPCC, 2007). The idea that the Earth's climate is changing and its effects on our daily life are now almost universally accepted in the scientific community (Cooney, 2010; Corfee- Morlot *et al.*, 2007). The CO2 concentration reached a level of 386 ppm in 2009 and increased further to 389 ppm. This is an increase of about 110 ppm (+38%) compared to the pre-industrial levels (i.e. before 1750) (NOAA, 2011). The Nitrous oxide (N2O) concentration in 2009 was 322 ppm, up 0.6 ppb from the year before (Encyclopaedia Britannica). In the last century, considerable changes took place in the gas composition of the atmosphere due to natural processes and anthropogenic activities, such as increasing energy consumption, industrialization, and intensive agriculture, urban and rural development. As a result, led to arise in global temperature and high spatial and temporal variability. The changing the temperature regime would result in considerable changes in the precipitation pattern there for Soil water regimes are considerable changes which effects on microbial activity, salt concentration, soil structure (aggregate) that's are intricately linked to the atmospheric–climate system through the carbon, nitrogen, and hydrologic cycles.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Effects on soil physical properties

Soil structure and Aggregate stability

The arrangement and organization of primary and secondary particles in a soil mass are known as soil structure where the amount of water and air present in the soil. Aggregate stability, the resistance of soil aggregates from the high intensity of rainfall and cultivation is determined by soil structure. It is also being used to measure soil erosion and management changes. The behaviour and quality of the structure is strongly influenced by the amount and quality of organic matter present, inorganic constituents of the soil matrix, cultivation methods and natural physical processes such as shrink-swell and freeze-thaw behaviour. Due to the variation of rainfall distribution and higher or lower temperature which decline in soil organic matter levels lead to a decrease in soil aggregate stability, infiltration rates and increase in susceptibility to compaction, runoff furthermore susceptibility to erosion

Porosity

Porosity a measure of the void spaces in material as a fraction (volume of voids to that of total volume) and pore size distribution provides the ability of soil to store root zone water and air necessary for plant growth. Pore size distribution is strongly linked to soil physical quality, bulk density, microporosity and functions of the pore volume. Soil porosity and water release pattern or amount of water release are directly influenced a range of soil physical properties which are soil aeration capacity, plant available water capacity and relative field capacity. Since root development and soil enzyme activities are closely related to soil porosity and pore size distribution. Climate change scenarios which are elevated CO2 and temperature, variable and extreme rainfall events that may alter root development and soil biological activities; as a result soil porosity and pore size distribution consequently soil functions are likely to be affected in a wrong way or lethal directions. It will lead to poor crop emergence, growth and increases chances of surface runoff

Bulk density

Bulk density is the most important feature of the soil physical property, which characterizes the state of soil compactness in response to land use and management. It has, in general, negatively correlated with soil organic matter (SOM) or soil organic carbon (SOC)

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

content. Due to elevated temperature may lead to increase in bulk density because the losses of organic carbon which leads to making soil more prone to compaction viz. land management activities and climate change stresses from variable and high-intensity rainfall and drought events (Birkas *et al*., 2009)

Effects on Soil Chemical properties

Soil pH

Soil pH characteristic is depending on the parent material, time of weathering, vegetation and climate. It is an important indicator of soil health. Soil pH is an integral part of soil health tests to assess impacts of land-use change and agricultural practices. These drivers of climate change (variation of rainfall intensity and temperature) which will affect organic matter status, C and nutrient cycling, plant available water and hence plant productivity, which in turn will affect soil pH (Reth *et al*., 2005)

Electrical conductivity

Soil electrical conductivity (EC) is another important feature of soil chemical property which is the measure of salt concentration. It can inform trends of soil salinity, crop performance, nutrient cycling and biological activity. Due to the Increasing temperatures and decreasing precipitation increase the electrical conductivity under climate change scenarios. The dynamics of soluble salts concentration in soils from four climatic regions (Mediterranean, Semi-arid, Mildly arid and Arid) are found a non-linear relationship between the soluble salts content and rainfall intensity.

Sorption and Cation exchange capacity

Sorption(Adsorption and absorption) and cation exchange capacity (CEC) are considered important properties, particularly the retention of major nutrient cations Ca2+, Mg2+, K+ and immobilization of potentially toxic cations Al3+ and Mn3+. These properties are useful indicators of soil health that is inform the soil's capacity to absorb nutrients. Due to the pore size variation of coarse-textured soils have low CEC and low-activity clay that is attributed to the SOM, the increasing decomposition and loss of SOM due to elevated temperatures may lead to decreasing the CEC of these soils. It may results in increased leaching of base cations in response to high and intense rainfall events.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Plant available nutrients

Measurement of extractable nutrients may provide the indication of a soil's capacity to support plant growth that may identify critical or threshold values for environmental hazard assessment (Dalal and Moloney, 2000). Nutrient cycling, especially N is intimately linked with soil organic carbon cycling . The drivers of climate change such as elevated temperatures, variable precipitation and atmospheric N deposition are likely to impact on N cycling and the cycling of other plants available nutrients such as phosphorus and sulphur. It's may also create some hazardous effect of some of the micro and beneficial element through the process of sorption and desorption due to variability of elevated temperature and high rainfall intensity

Effects on Soil Biological properties

Soil organic matter

Soil organic matter is originated from an extensive range of living and non-living components. It is one of the most complex and heterogeneous components of soils which vary in their properties, functions and turnover rates. It possesses the ability to form a complex with multivalent ions (cations and anions) and organic compounds. It provides microbial and faunal habitat and substrates, as well as affecting aggregate stability, water retention and hydraulic properties of soil. SOM contribute the vital and core function where, decreases in SOM can lead to a decrease in fertility and biodiversity, as well as a loss of soil structure, that resulting in reduced water holding capacity, increased risk of erosion and increased bulk density and soil compaction. The drivers of climate change such as elevated temperatures, variable precipitation which leads to decrease SOM by oxidised the organic matter as a result deteriorated the soil quality

Light fraction and Macro organic matter (Labile organic matter)

Light (low-density) fraction and macro organic components of SOM consist mainly of mineral-free particulate plant and animal residues, which serve as readily decomposable with the variation of temperature and oxidised easily, therefore, labile nutrient reservoir are decline inversely. Since light fraction and macro organic matter are responsive to management practices, which act as early indicators to measure the effectiveness of changing management practice in the adaptive response to climate change (Knorr *et al*., 2005)

Potentially mineralisable C and N

Mineral sable organic matter acts as an interface between autotrophic and heterotrophic organisms during the nutrient cycling process. Mineral sable organic matter may be a useful indicator to assess soil health under climate change because of its affects nutrient dynamics within single growing seasons. Due to the variation of climate change which leads to change the quantity of organic matter through the oxidation.

Soil respiration

Soil respiration is used as a biological indicator for soil health, and it is positively correlated with SOM content. It has a critical link between climate change and the global C cycle. It is relatively responsive to changes in the seasonal timing of rainfall.

Enzyme activity

Soil enzyme activities may serve to indicate change within the plant-soil system due to its close association of rhizosphere. It is closely linked to the cycling of nutrients and soil biology; however, the elevated of CO2 may stimulate microbial enzyme activities, an abundance of microbial enzymes and C turnover possibly affecting microbial community functioning in soil.

Conclusion

The quantitative and qualitative evaluation of predicted climate change effect on soil health is a difficult task due to uncertainties in the weather forecast. Conservation farming has shown positive results in minimizing land degradation. It is advisable to adopt the conservation tillage and residue management, which is essential that complete package of practices may be identified based on intensive research for each agro-ecological region. The site-specific management practices for soil and water conservation, crop improvement and integrated nutrient management needs to be implemented to overcome the impact of climate change on physical, chemical and biological properties of soil. It is also advisable that increase of afforestation and reduces the deforestation to mitigate the climate change and also take the initiative to bring the problematic zones of soils into the form of some extends to cultivable form so that the intensive pressure of already cultivable land can some extend minimized. Govt should take some awareness programme regarding the effect of climate change towards

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

the soil health with the help of extension worker. Lastly, not least the most important factors to mitigate climate change towards soil health is a public awareness and public responsibility towards the environment.

References

Birkas M, Dexter A, Szemok A. 2009. Tillage induced soil compaction as a climate threat increasing stressor. *Cereal Res. Commun*. 37:379-382

Cooney, C.M., 2010, The perception factor: Climate change gets personal. *Environ. Health Perspect*., 118(11):A484–A489

Corfee-Morlot, J., Maslin, M. and Burgess, J., 2007, Global warming in the public sphere. *Philos. Trans. R. Soc. London. Ser.A* 365:2741–2776. *Renew Agric. Food Syst*., 24:214–224

Dalal RC, Moloney D. 2000. Sustainability indicators of soil health and biodiversity. In: Hale P, Petrie A, Moloney D, Sattler P. (eds.), Management for sustainable ecosystems. Centre for Conservation Biology, Brisbane, 101-108.

IPCC. 2007. Climate change 2007 synthesis report. In: R.K. Pachauri and A. Reisinger, editors, Working group contributions to the fourth assessment report of the intergovernmental panel on climate change. Cambridge Univ. Press, Cambridge, UK

Knorr W, Prentice IC, House JI, Holland EA. 2005. Long term sensitivity of soil organic carbon turnover to warming. *Nature*. 433:298-301.

Reth S, Reichstein M, Falge E. 2005. The effect of soil water content, soil temperature, soil pH-value and root mass on soil CO2 efflux-A modified model. *Plant and Soil*. 268:21-33.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

EFFICACY OF DIFFERENT COMPANION CROPS TO DEBAR ARTHROPOD PESTS IN BRINJAL ECOSYSTEM

Article Id: AL202056

Mainak Bhattacharyya

Department of Agricultural Entomology Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal

Email: mainakbckv24@gmail.com

Modernization of agriculture implies increased use of modem inputs such as chemical fertilizer, irrigation and modern seeds, which provide a favourable climate for the rapid growth of pests. The use of pesticides, however, carries several dangers. Non-optimal and non-judicious use of pesticides may result in a series of problems related to both loss of their effectiveness in the long run and certain externalities like pollution and health hazards. It is argued that the increase in production cost, when associated health costs are counted due to use of pesticides, exceeds the improvement in crop productivity. According to Marie Lannotti , 2020 Companion planting is an age-old tradition, especially for vegetables. It's a gardening technique that involves planting two or more plants near each other to derive some type of benefit. That benefit could be more vigorous growth, higher yield, repelling pests, or attracting the predators of common pests. However, Annette Wszelaki, 2012, companion crops are grown as a control measure to lure pests away from the cash crop to protect it from attack. Pests are either prevented from reaching the crop or concentrated in certain parts of the field away from the main crop. Since most of the pesticides are toxic in nature, their continuous use leads to their entry into the vertebrate food chains, which in turn ecological disbalance and biomagnification. Injudicious application of broad-spectrum toxicants leads to the debilitation of beneficial insects and natural enemies, together with the population decline of natural foragers who are directly involved in crop pollination and productivity increase. They also result in the resurgence of pests and development of resistant biotypes in insects. According to the World Ecology Report(Vol-29), Spring 2019 It is estimated that globally there are about 5.6 billion pounds of pesticide used annually and there are some 25 million agricultural workers who are poisoned (Jeyaratnam, 1990).

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

History of using Companion crops

In terrestrial ecosystems, plants not only extract nutrients from the soil, but also affect the soil physical and chemical conditions through processes such as the depletion of nutrients, incorporation of atmospheric elements, secretion of root exudates, and context-dependent accumulation of organic matter (Bever et al., 1997; Wardle et al., 2004; Harrison and Bardgett, 2010). According to Blaauw B.R., et al.,2017 It has been observed that polycultures of crop species often lead to less damage from pests than monocultures of crops within a given area. One explanation for this was proposed by Root, that polycultures can enhance biological control by offering greater host capacity for natural enemies while simultaneously complicating the pest habitat. A habitat manipulation through trap cropping capitalizes on the strong perimeter-driven behaviour in multiple cropping systems. Furthermore, while explaining the quality of an efficient companion or trap crop Shelton A.M., Badenes-Perez F.R(2006) An efficient trap crop system should have at least double the pest attraction capacity of the cash crop during its vulnerable stage with an easy management strategy and should cover no more than 2%–10% of the total crop area.

Natural enemy populations effectively increase in the trap crops, which are significantly useful for the biological control of pests. Thus using companion crops/trap crops could result in the olfactory manipulation on the part of the natural enemy population as described by Zhu J., Cossé A.A., who illustrated that Male and female *Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae) adults will respond to several semiochemicals produced by corn (*Zea mays* L. (Poaceae)), as well as a prey species of aphid (*Acyrthosiphon pisum* Harris (Homoptera: Aphididae). However, marigold as a companion crop is highly effective in debarring herbivores from a crop ecosystem. Marigold, *Tagetes erecta* L.(Asteraceae) is a versatile plant with potential for pest management. Marigold rows next to onion fields resulted in a higher number of entomophagous species, potentially enhancing the natural control of onion pests and providing an alternative to crop sprays for organic control of onion pests (Silveira *et al*., 2009). Marigold also possesses nematode suppressive potential that should be explored further as a green cover crop. Marigold is well known for its ability to produce compounds such as α-terthienyl that are allelopathic to many species of plant-parasitic nematodes (Hooks *et al*., 2010).

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Companion Crops to debar arthropod pests

Companion Planting (Allelopathy) is based on the principle that certain plants can attract or repel insects or provide beneficial support to other plants. It can also work the other way around where one plant can be detrimental to another's growth. A companion crop may be selected because it is comparatively more attractive to pests and serves to distract them from the main crop. They also improve the nutrient content of the soil, if especially legumes are used as companion crops like beans, cowpea, peas. Companion planting can enhance biological pest suppression through allelopathy, which is a biological phenomenon where an organism produces one or more biochemicals that influence the growth, survival, and reproduction of other organisms like African marigold are known to produce thiophene which repels nematode attack. Certain other companion crops like black cumin, coriander, onions, tomato, garlic, turmeric are known to emit allelochemicals which acts as a stimulo-deterrent to the pests which repel the insects from the main crop.

Name of the companion crops	Pest deterred	Cause of pest deterrence	Accompanying crops
Onions	Thrips, Yellow mosaic virus	Host plant for these pests	Carrot, Buckwheat
Marigold	Borers, jassids, aphids, whiteflies, nematodes	Thiopenes, and other volatiles	Solanaceous crops
Maize	Whitefly, jassids, Epilachna beetle, borers	Barrier crop due to height	Wheat and other crops
Sweet potato	Epilachna, jassids, whiteflies, aphids etc.	Succulency of the companion crop	All crops(but periodic pruning must be done)
Cowpea	Colorado potato beetle, aphids	Natural enemy harbouring	Vegetables, cucumber
Basil	Aphids, flies, borers, spider mites	Estragole and tarragon	Tomatoes and Asparagus

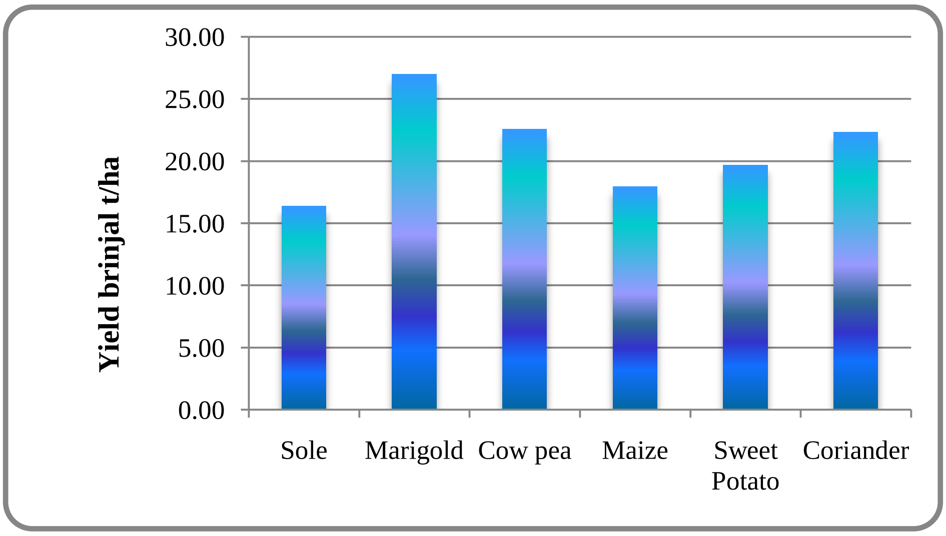
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Companion crops gives added income

Multiple cropping could be one of the viable alternatives to cope uncertainties and changes, where food and nutritional uncertainty looming large. The ultimate outcome of multiple cropping could be visualized in an adverse or harsh environment for increase agriculture production, livelihood and income. Various food products are obtained through multiple cropping. Land equivalent ratio (LER), relative yield total (RYT) and income equivalent ratio (IER) can be increased with mixed/intercropping systems. According to Mina Nath Paudel ., Dec2016 in the tropics, smallholder farms, which produce over 60% of the food resources of developing nations from intercropping of cereals with many crops mostly legumes. The system equivalent yield of the companion crops and the main crop are always greater than the sole crop in the monoculture under same agronomic and meteorological conditions. Thus for companion cropping B:C ratio is always remunerative (>1) while for monoculture, injudicious use of pesticides and agrochemicals only give remunerative returns otherwise for sole cropping B:C ratio always is non economic (< 1).

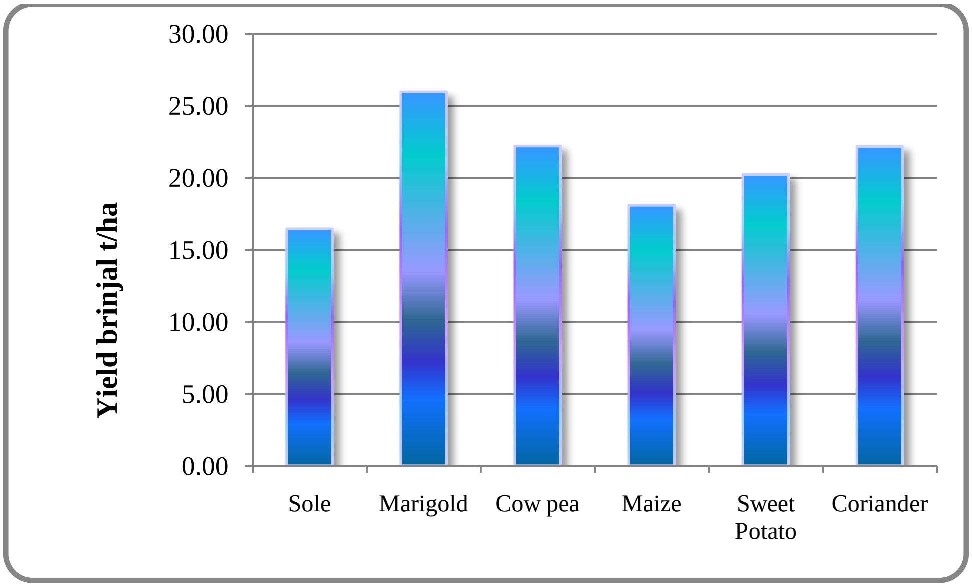
Experimental research conducted with brinjal and different companion crops for yields

Experimental research conducted in The field experiments were carried out at the Central Research Farm of the university, Gayeshpur, West Bengal (Geographical location- Latitude 23°N, Longitude 89°E, Altitude 9.75m msl) with main crop brinjal with a combination of different companion crops on winter brinjal, 2017 and 2018 recorded various yield results of brinjal with different companion crops without the use of chemical pesticides.



Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

During winter brinjal crop 2017, the yield for sole brinjal was 16.36 t/ha, while for brinjal+marigold combination, the marketable yield for brinjal was 26.99 t/ha, for cow pea+brinjal the yield for brinjal was 22.57 t/ha. However, for maize+brinjal, sweet potato+brinjal and coriander+brinjal, the marketable yield of brinjal fruits were 17.93 t/ha, 19.68 t/ha and 22.34 t/ha respectively.



During the winter crop of 2018, the marketable yield for sole brinjal was 16.45 t/ha without any pesticide spraying, whereas for marigold+brinjal companion combination the yield was 25.95 t/ha. The brinjal fruit yield for cow pea+brinjal combination was 22.20 t/ha. However, for maize+brinjal, sweet potato+brinjal and coriander+brinjal companion combinations, the marketable yield of brinjal fruits were 18.09 t/ha, 20.23 t/ha and 22.16 t/ha respectively.

Conclusion

Companion planting is a specific type of polyculture under which two plant species are grown together that are believed, to synergistically improve one another's growth and all add an economic surplus to the production. Companion plants are brought together because they directly mask the specific chemical cues that one another's pests use to find their hosts, or because they hold and retain particularly effective natural enemies of one another's pests. Companion plants can control insect pests either directly, by discouraging pest establishment, and indirectly, by attracting and harbouring natural enemies and predators that kill the pest. The ideal companion plant can be harvested, providing a direct economic return to the farmer in addition to the indirect value in protecting the target crop. However, "sacrificial"

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

companion plants which themselves provide no economic return , or when the cost of cultivation of the companion crops exceeds its net economic returns.

References

Blaauw, B.R.; Morrison,W.R.; Mathews, C.; Leskey, T.C.; Nielsen, A.L. 2017. Measuring host plant selection and retention of Halyomorpha halys by a trap crop. *Entomol. Exp. Appl.* 163, 197–208.

E. K. P. O. Ogol and J. Makation, 2007 Potential of companion crops in managing the diamond backmoth in cabbage /kale cropping systems in Kenya. *African Crop Science Proceedings*, 8, 1029-1033.

Geetha, B., Swamiappan, M. and Kempuchetty, N. 2002. Predators for the biological control of the spiraling whitefly *Aleurodicus dispersus* on vegetables. In: International Conference on Vegetables. Nov.11-14. Bangalore, India:pp.261.

Potting RPJ., Perry JN. & Powell W., 2005. Insect behavioural ecology and other factors affecting the control efficacy of agro ecosystem diversification strategies. *Ecol. Model*, 182: pp.199–216.

Smyth, R.R.; Hoffmann, M.P.; Shelton, A.M. 2003 Effects of host plant phenology on oviposition preference of *Crocidolomia pavonana* (Lepidoptera: Pyralidae). Environ. Entomol. 32, 756–764.

Wargantiwar, R. K., Ashwani, K. and Saima K. 2010. Bioefficacy of some botanicals and in combination with insecticide against *Leucinodes orbonalis* (Guene) in brinjal under Allahabad agro-climatic condition. *International Journal of Plant Protection*. 3(2): pp.245-247.

W. Kumar, A. Mishra, A. K. Verma, R. Roy. A. Tripathi, M. K. Ansari, M. Das and P. D. Dwivedi, 2011GM Crops, 2, 92-98.

Zhu, J., Cossé, A.A., Obrycki, J.J. *et al.* 1999. Olfactory Reactions of the Twelve-Spotted Lady Beetle, *Coleomegilla maculata* and the Green Lacewing, *Chrysoperla carnea* to Semiochemicals Released from Their Prey and Host Plant: Electroantennogram and Behavioral Responses. *J Chem Ecol* 25, 1163–1177.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

SOCIO-ECONOMIC STATUS AND CONSTRAINTS OF WEAVERS IN SITAL PATI PRODUCTION IN COOCH BEHAR DISTRICT OF WEST BENGAL

Article Id: AL202057

Tarun Kumar Das[1], Biman Maity[1*] and Kausik Pradhan[1]

[1]Department of Agricultural Extension
Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal

Email: biman100002@gmail.com

Sital patis or sital mats render a feeling of coolness (thus rendering the name 'Sital' or 'Sheetal') to the person sitting or sleeping on it and are intimately linked with everyday rural life [1](http:// www.coochbehar.nic.in). Murta (plant, used for making cool mate) is the main ingredient in mat weaving. The cool mat is locally called as sital pati in Cooch Behar district of West Bengal in India. The making or production of sital pati is purely household entrepreneurship. It can be used for multi-purpose work, the ancient people used to make different items all around the years. According to the sital pati makers, the art of making cool mat was started for a long time back in the district, and in some families, it became a tradition. It was said that the art of making a cool mat initially was considered auspicious regarding the rituals and religious purposes in Barak Valley. Donate cool mat in Hindu marriage is ritual or tradition for a long time back and still going on. Generally, Murta grows on marshy or waterlogged areas or damp hill slopes. Pankaj Kr. Rabha, 2012 reported that the minor forest resources provide the entrepreneurs raw materials to produce broom (Jaru) comments (sital pati), cane hats (japi) etc. (There is two common variety are observed in this area or a nearby state. 'Khag is one of the varieties which has no joints or internodes in the plant, but there is another variety which has joints or internodes in the plant. While making a cool mat, actually men carry murta from the field to their houses or working area then prepare the cane slips cutting, where women do the weaving work. Many of the artisans engaged in this craft in different parts of Northeastern states especially Assam and Bengal and various parts of India. Many places in Cooch Behar district the people are

engaged in this activity. The role of women workers is very significant in the handicrafts industry as 90 percent of workers in sital pati and Madur industry are female workers (Sarkar, 2012). It is seen that most of the families in some parts of the district are totally dependent on this activity for his/her livelihood sustainability. It is totally homely made activity, and it does not require any specific or larger space to run the activity. It can be done during the rainy season, also if the material (murta) is available. At present, the emerging use of plastic causes greater harm to our society as well as the environment to a larger extent. Though the people were of it but did not care for it. The entrepreneurship cool mat weaving need to be the focus because it is sustainable, economically, and sociable viable, suitable for the environment nowadays.

Methodology

The study was conducted at Ghugumari, Varokodali, Deocharai and Dholuabari village of Cooch Behar district of West Bengal. The study area is mainly dominated by the different community, and the majority of the household is engaged in the preparation of cool mate. Randomly 40 numbers of respondents who are fully engaged in this entrepreneurship were selected for the study. An interview schedule was designed to collect the primary information for the selected respondent. Secondary data were collected from village panchayat pradhan, middleman, literature, research paper and internet.

Finding

Exposure

In the study, it was found that the majority of the weaver has not received any training on it. Because they have learned it from their parent or grandfather and neighbours. Now a day, in various places, many micro teaching centres were established and every block conducting training in this entrepreneurship development, but it was seen that 85% of the participants were young aged person/lady. Old aged weavers thought that the need for professional training on this is not required as the knowledge or skill related to cool mate enterprise had been acquired from parents or grandparents.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Previous occupation

It was found that the majority of the mat weaver engaged in this activity since their childhood and their parent and grandparent were also in the same profession. It was also observed that some of the mat weavers were cultivated rice only for home consumption but not for commercial purposes.

Pricing of sital pati

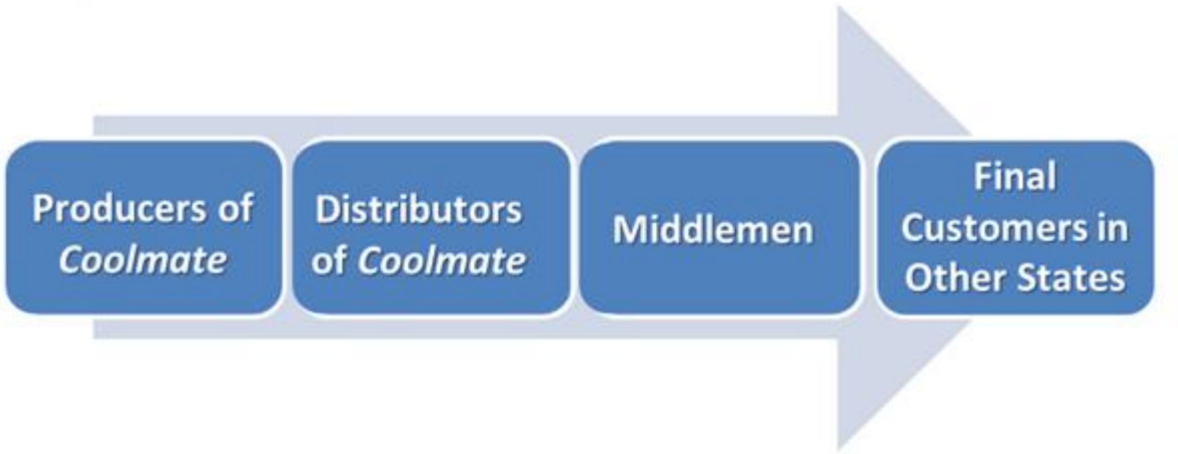
During the study, it was found that the size of the mat defined the price of the product. The producers or weavers make the mat in different sizes i.e., 5x7 foot, 6x7 foot and 3x6 foot. The price of the normal sital pati or mat ranges from Rs. 350/- to Rs. 750/-. The sital pati having the size of the 5x7 foot is considered as a standard size and has more demand in the market compared to the other side of the mat. The cost of the 5x7 foot size mat is Rs.350/- and it takes fourteen hours to make the mat by the weaver or producer. Whereas the cost of mat size of 3x6 foot is Rs. 200/- only.

In the survey, an average size (5x7 foot or 6x7 foot) of pati which is sold by the producer to the distributor is cost around Rs.350/- and the distributors sell it to the middlemen at Rs.500/-. The middlemen again sell it outside the state at an average price of Rs. 2000 or more.

Market and marketing channel

The distribution of the marketing channel of handicraft products, especially in sital pati is not in proper shape. Three categories of the agency are associated in this marketing process. In the first category, the middleman collects the pati or mat from the doorstep of the producer at a cheaper rate. After the collection of pati or mat from the producer, the first agency will sell the product to the second agency who has financially stronger than the first one. And the second agency was act as distributors of the products. The third party is the middlemen which exist in all systems. The second party or distributor will again sales the products to the middleman with some margin in the weekly or daily local market. The middlemen will sell the products outside the state at a higher rate. It has good demand in South India and even in foreign countries. Thus, an entire process, the middleman earned maximum benefits with minimum investment, time and manpower. In someplace it was also seen that when the producer had many nos. of pati or mat to sale, then he/she used to sell the product directly to the second party in the local market instead of selling it to the first party.

Fig 1: Marketing channel of Sital pati in Cooch Behar district



Value addition

The value addition of pati is a very common instance among the entrepreneurs when there is assure demand in remunerative prices. Actually, the value addition process in making the cool decorative mat. For this reason, many of the weavers are not interested in value-added product development.

Communication enhancement

The development of an enterprise through the successful implementation of different embedded activities related to the production aspect and marketing aspect enhancement professional skill of communication with the people due to fixing the price during negotiation. It also develops the communication network for product and marking of entrepreneur products through the establishment of linkage among the middleman, buyer, marketing personnel, govt official and agencies.

Attitude towards enterprises

It has been found that the weavers are quite satisfied with their cool mat enterprise. The plausible reason behind this may be that they can prepare the cool mats within their house premises, which not only saves their time but also helps them manage their various important household activities. Moreover, they can engage their children in some activities related to cool mat preparation. This again reduces the cost as well as enhances the profit of the enterprise; that is why the pati producers have developed a favourable attitude towards the enterprise.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Occupation diversification

The Muslim community is also perceiving the interest towards this enterprise as it is less labour intensive, and the family members can also be utilized.

Table.1. Ranking of various constraint faced by the weaver in making of coelomate

Sl. No.	Problems	Rank
1.	It is a time-consuming and laborious activity.	VII
2.	Expected benefits were not obtained from the product.	I
3.	The women workers engaged in entrepreneurship suffer from back pain, eye problems and spondylitis.	VIII
4.	It required land for cultivation, otherwise, landless weavers need to buy the murta or slips from the outside or market.	IV
5.	No established market is available in rural areas where they can get a satisfying price.	V
6.	In mat, the weaver is still practicing manually. There is no modern technology was developed for the mat weaver. At present, poor technology is affecting their production both in quality and quantity in the competitive market.	VI
7.	Popularization and reduced at the price of plastic in the market giving threat to the coot mat weaver in the handicraft industry.	II
8.	The network for credit facilities by the financial institution to the micro and handicrafts sector is very poor.	III

Though the many weaver difficulties in the production process but still many people considered it a source of sustaining livelihood. The enterprise does not require a specific place to start and can be produced whole round the year.

The prior problems associated with this enterprise is the non-realization of expected benefits followed by less popularity of cool mate due to plastic mat and unavailability of the credit network.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Conclusion

The sital pati is economical and profitable entrepreneurship for rural women, landless and marginal farmers in the rural area. Nowadays, many people or communities are engaging in this entrepreneurship for the sustainability of their livelihood. The government needs to focus on this entrepreneurship seriously in the promotion and popularizing the activity because it is economical, sustainable, environmentally viable and pollution-free but now a day's emerging plastic materials causing pollution to our environment greatly. Improvement in infrastructural facilities, development in entrepreneurship qualities, adequate institutional credit support and use of modern technology in the industry would ensure the long-term growth of entrepreneurship.

References

ICH Courier online. Intangible Cultural Heritage Courier of Asia and the Pacific. Sital Pati: A Traditional Handicraft of Bangladesh.

Sarkar, D., 2012. Status of Rural Women, Left Behind for Male Labour Circulation: An Empirical Study of Cooch Behar District, West Bengal, India, *Research on Humanities and Social Sciences*, 2(9):103-111.

Rabha Pankaj Kr, 2012. Forest Resource Entrepreneurship- a case study of Goalpara district of Assam. IJCAES Special Issue on. Basic, Applied & Social Sciences, Volume II: 361-363,[ISSN: 2231-4946].

http://coochbehar.nic.in/htmfiles/Handicrafts.html. (Accessed on 31 Jan, 2018)

http:// www.coochbehar.nic.in[1]

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

SMART SULPHUR MANAGEMENT FOR INCREASED PRODUCTIVITY AND QUALITY OF INDIAN MUSTARD (*Brassica juncea* L.)

Article Id: AL202058

Pramod Kumar[1], Suresh Kumar[2], Subhradip Bhattacharjee[3*] and Sheilendra Kumar[4]

[1]Department of Agronomy, CCSHAU, Hisar, Haryana, India- 125004
[2]Directorate of Research, CCSHAU, Hisar, Haryana, India-125004
[3]Agronomy Section, ICAR- NDRI, Karnal, Haryana, India-132001
[4]Department of Agronomy, SKRAU, Bikaner, Rajasthan India- 334006

Email: subhradip25@ndri.res.in

Sulphur as it is rightly called the fourth major secondary plant nutrient for all significant crops for its essentiality toward growth, development and yield. It plays a pivotal role in different physiological and biochemical functions in the plant. However, sulphur deficiency is one of the significant nutritional deficiency in the plant as more than 70 countries around the world are facing it, and India is no exception. Sulphur is essential in a plant for promoting oil synthesis, along with a constituent of seed protein, amino acid, enzymes, chlorophyll and glucosinolate. Sulphur is even more critical when it comes to repassed and mustard where it plays a vital role in determining yield, oil quality and quantity, and resistance to various stress. Among all the field crops; rapeseed and mustard have the highest requirement of sulphur. Various researches concluded that sulphur increased the yield of mustard by 12 to 48% under the irrigated condition and 17 to 124% under rainfed conditions. If we consider the Agronomic efficiency, each kilogram of sulphur increases the yield of Indian mustard by 7.7 kg. If we consider the uptake of sulphur by Rapeseed (*Brassica competes* and *Brassica rapa L*.) with a cereal like Barley, it has been observed that the former requires 3-10 times more sulphur.

However, the availability of sulphur to the plant for uptake is decreasing day by day. The prime reasons can be argued that of using high yielding crop varieties and multiple cropping per year coupled with high analysis sulphur-free fertilizers that are too in the absence of regular supply of organic manure in the soil. Currently Indian is facing a massive gap of N: P_2O_5: K_2O: S which is around 14.7: 5.1: 1.6: 1 a level far below the desired limit and hence required urgent attention to enhance it through the adoption of advanced techniques developed for sustainable sulphur management. As per the new Oilseed mission of India; the average productivity of rapeseed and mustard is only 1145 kg/ha which needs to be enhanced to 2562 kg/ha by the end of 2030 for self-reliance in edible oil. Attaining such level of productivity is not possible without comprehensive sulphur management practice. A deficiency oriented nutrient management is the only way forward to achieve the goal.

Sulphur in soil

Sulphur in the soil generally remains as a compound form of a heterogeneous mixture of plant residues, animal and soil microorganisms. The mobility of sulphur in soil is like nitrogen as it moves very rapidly, especially in sandy soil. Like nitrate, sulphur is also negatively charged and subjected to leaching into the subsoil. As a result, the availability of sulphate is less in topsoil (upper 30 cm). IN the subsoil the sulphate is absorbed by the iron and aluminium oxides. The accumulation of sulphate in subsoil depend upon the acidity of the subsoil; with increasing acidity, the accumulation of sulphates in the subsoil also increases. This accumulation relies on the mineralization of organic matter to sulphate and mineralization depends upon the C: S ratio. The critical range of C: S ratio lies in between 200-300:1. When the C: S ratio reaches below 200: 1, the net mineralization happens, and if it is above 300: 1, the immobilization occurs. The immobilization occurs when the organic residue contains less amount of sulphate as the microbes in soil tends to lock it down. The sulphate loss can also occur due to volatilization as hydrogen sulphide (H_2S) under waterlogged condition.

Most of the Indian soils especially the soils of Indo- Gangetic plains, red, lateritic and hill soils are deficient in sulphur while coastal soils have an abundant level of sulphur. The sulphur deficiency has also been reported form calcareous soils because of their low organic matter content. On the other hand, most of the saline soils and acid sulphate soils of mangroves contain an excessive amount of sulphur which is toxic to plants. So, it can be concluded that the availability of sulphate in the soil varies quite a bit from place to place.

The response of Indian mustard to sulphur

Indian mustard is specifically sensitive to sulphur availability. It requires around 0.33-0.40% sulphur in leaves for obtaining 90% of its potential yield. In the case of plant tissue, it requires one part of sulphur for every 15-20 parts of nitrogen for optimum growth and yield. On a dry matter basis, the sulphur should occupy 0.1-0.6% as an optimum range. The

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

partitioning studies reveals that the maximum S concentration lies in the leaves followed by stem while the lowest in roots. During the sulphur deficiency, accumulation of amides and carbohydrate happens in leaves which in return hampers the development of chlorophyll and causes stunted plant growth and yellowing of young leaves. Sulphur is also behind the glycoside of mustard which causes distinct odour and pungency.

It has been observed that yield attributes of Indian mustard increased significantly with an increasing application rate of sulphur upto 45 kg/ha; however, the optimum seed yield and oil yield of Indian mustard occurred at about 20 kg/ ha of sulphur. Again, the application of sulphur in the even higher rate (100 kg/ha) causes higher uptake of sulphur in the plant. Deficiency of S results in severe yield losses to Indian mustard, due to its higher demand for the synthesis of protein, co-enzymes, S- containing amino acids and glucosinolates. When the sulphur level falls below the desired level, it causes disruption of nitrogen metabolism.

Optimum sulphur management in Indian mustard-based cropping system

Application of sulphur at a rate of 40 kg/ ha has been found superior in the majority of Indian mustard-based cropping system. Not only the application rate but the source is also significant for optimum sulphur management. Bentonite S as a source of sulphur gives significantly higher growth, yield attributes and yield as compared to gypsum and wettable sulphur. Genotype and its response is also an essential factor as varieties like Varuna and Kranti produced higher yield with and sulphur application rate of 20 kg/ha as compared to Pusa bold with 30 kg/ha of sulphur. When Indian Mustad is grown under Indian mustard-black gram cropping sequence, the application of sulphur at a rate of 20 kg/ha is sufficient to meet the demand for both crops. Another interesting fact is that although protein and oil content is negatively correlated; but the application of sulphur in proper amount resulted in increments in both factors. The increase in oil content of seed mustard is related to increase in in acetyl-CoA carboxylase activity, which is also the precursor for oil synthesis. Foremost, sulphur is a constituent of methionine, the first amino acid required in the protein synthesis (acetyl-CoA carboxylase). Subsequently, sulphur is associated with the proper functioning of nitrate reductase, the enzyme regulating the flow of NO_3-N into the amino acids and finally into protein synthesis. Although the application of sulphur resulted in an increase of oil

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

contents in all rapeseed and mustard species, the best result has been observed in Indian mustard.

Another famous cropping sequence, especially for the desert area, is guar- *taramira* sequence. In this sequence application of 40 kg, sulphur/ ha has been found to be best in maximum cases.

Method and time of sulphur application

Application of right amount of sulphur is not the only aspect of holistic sulphur management for improved sulphur use efficiency; it also includes the proper method and time of application. The foremost step should be the initial soil analysis to get a fair idea about the status of all available nutrients in the soil. Nutrient management with any nutrient is not straight forward because of interactions among nutrients and sulphur is no exception. The second most crucial point that should be considered is the physiological stage of the plant to determine the proper timing. Just like the nitrates, sulphur is leachable hence smaller split doses during the various nutritionally critical phase is essential. This factor becomes even more necessary in case of sandy soils. The most commonly followed method is band application; however, labour can be saved in case of broadcasting which is possible if sufficient rainfall has occurred or assured irrigation is present. Various researches indicated that a similar quantity of seed yield could be obtained in case of broadcasting as compared to side dressing if continuous moisture is maintained in the field. It is because of the fact that the mineralization rate of sulphur is highest for *Crucifers* (57- 85% of total applied sulphur) while the lowest is for legumes (47% of total applied sulphur). The best time of sulphur application is before the sowing has been done. Although; if the sulphur is not used before the planting, application during the bolting stage can significantly restore the yield while during flowering; it can partially fill up the deficiency gap. Inside the plant; sulphur is less mobile than nitrogen. The requirement of sulphur in mustard is more during the initial stage; hence complete doses should be applied before the bud initiation. The fertilizer application should be made if the nitrogen: sulphur ratio reaches above 15: 1.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Source of sulphur and integrated use strategy

Sulphur does not have any cheaper nutrient source; hence judicious use is the key to economic sulphur management. Based on different requirements, the right source should be selected, as mentioned below:

Table 1:various sources and management approach of sulphur-containing fertilizers

S No.	Fertilizer	S content (%)	Management approach
1.	Elemental S	85	Best suitable for fine-textured calcareous soil. Should be applied 3-4 weeks before planting.
2.	Ammonium sulphate	24	Suitable for integrated use along with nitrogen. Best suitable for topdressing.
3	Pyrite	22	Best suitable for surface dressing in alkaline soil
4	Gypsum	18	Most suitable for the crop with high calcium demand
5	Potassium sulphate	18	Best suitable for integrated application with potassium in chlorine sensitive crops.
6	Single superphosphate	16	Integrated use with phosphorus as basal dose.
7	Zinc sulphate	15	Used in plants which also requires zinc in a higher amount.

[Source: Rathore *et al.*,2015]

If pyrite is to be used in calcareous soil; it should be in fine powder formed and should be applied 7-10 days before the sowing. Sulphur can also be used as fortified fertilizer such as mono ammonium and diammonium phosphate with 5% and 20% sulphur respectively. When sulphur is applied as granulated triple superphosphate and diammonium phosphate, the oxidation rate is much higher in both acid and calcareous soil.

Sulphur is also a great source of coating material for urea as control released fertilizer. Generally, the sulphur content in sulphur coated urea is 14-20%. This kind of mechanism is particularly helpful in case of delayed requirements of nitrogen.

Another aspect of sulphur management in Indian mustard is that use of organic matters. Application of 5-ton FYM along with 20 kg/ha of sulphur is mostly recommended. In the absence of FYM, pressed can also be used.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Conclusion

Sulphur, currently being considered as the fourth most crucial plant nutrient, is essential for higher production of crops, especially rapeseed and mustard. Sulphur is also responsible for three essential amino acids, namely cysteine, cysteine and methionine and hence crucial for protein synthesis. Current estimation suggests that till 2025, 2 million tonnes/year of sulphur will be removed from the soil. As compared to other significant nutrients, sulphur is much cheaper yet provides more return per unit money invested. Sustainable, balanced and integrated sulphur management not only increases the yield of Indian mustard but also the quality of it. With proper management, sulphur can play an important role to fill the vegetable oil production gap India is currently facing.

References

Amanullah, H. M., Hassan, M., &Malhi, S. S. (2011). Phenology and seed quality response of rape (B. *napus*) versus mustard (B. *juncea*) to sulfur and potassium fertilization in Northwest Pakistan. *J. Plant Nutr*, 34, 1175-1185.

Dash, N. R., & Ghosh, G. K. (2012). Efficacy of gypsum and magnesium sulfate as sources of sulfur to rapeseed in lateritic soils. *Journal of plant nutrition*, 35(14), 2156-2166.

Rana, K. S., Rana, D. S., & Gautam, R. C. (2005). Influence of phosphorus, sulphur and boron on growth, yield, nutrient uptake and economics of Indian mustard (*Brassica juncea*) under rainfed conditions. *Indian Journal of Agronomy*, 50(4), 314-316.

Rathore, S. S., Shekhawat, K., Kandpal, B. K., Premi, O. P., Singh, S. P., & Chand, G. (2015). Annals of Plant and Soil Research 17 (1): 1-12 (2015) Sulphur Management For Increased Productivity Of Indian Mustard: A Review. *Annals of plant and soil research*, 17(1), 1-12.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

VESICULAR ARBUSCULAR MYCORRHIZAE (VAM): A SUSTAINABLE APPROACH FOR SOIL PHOSPHORUS AND RAIN-HARVESTED WATER ECONOMY MANAGEMENT IN ACID SOILS OF WESTERN HIMALAYAN SOIL

Article Id: AL202059

Amrit Lal Meena[1*], SamleshKumari[2], NishaLekshmi V[3], and Sunil Kumar[1]

[1]ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250110
[3]Department of Community Medicine, Govt. Medical College, Kottayam, Kerala-686006
[2]ICAR-Central Institute of Agricultural Engineering, Nabibagh, Bhopal-462038

Email: amrit.iari@gmail.com

The present scenario reveals that the world population is increasing day by day whereas, food grain production is not increasing proportionately due to various factors such as decline in soil health and climate change phenomenon as manifested by unpredictable patterns of rainfall and temperature. The major reason for poor soil health seems to be the unbalanced nutrient application to crops. One of the most important strategies, particularly in the wake of the intense energy crisis is the improvement in fertilizer phosphorus use efficiency, which is the lowest amongst all plant nutrients. Fertilizer phosphorus has contributed tremendously towards increasing food production, yet even with best agronomic practices, the recovery of fertilizer phosphorus hardly exceeds 10-20 per cent because of the reason that most of the applied phosphorus get precipitated/ fixed and thus becoming unavailable for plant use.

A number of approaches such as liming, sub-soil placement, application of P in splits and dipping of seedlings into soluble P slurry, etc. aimed at increasing phosphorus use efficiency have been developed in India and abroad, but unfortunately, none of the above strategies has been found to be equally has been found to be equally effective under different situations. (Cordell *et al*. 2009). Among the first three macro-nutrients, phosphorus is one of the prime nutrients necessary for the growth of all forms of life on planet earth covering plants, animals and micro-organisms as a structural component of cell constituents *(cell membranes, chloroplasts & mitochondria)* and that of metabolically active compounds. Some important compounds of which P is a component are viz. sugar phosphates (ADP, ATP, etc.), nucleic acids, nucleoproteins, nucleotides, NADP, pyridoxal phosphate and thiamine pyrophosphate.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Above compounds actually play an important role in growth *(cell division and elongation)*, photosynthesis, respiration, energy storage/ transfer and several other plant processes. As such, phosphorus promotes early root formation and overall crop growth and thereby hastening maturity. Phosphorus improves the quality of fruits, vegetables and that of food grain crops, it being a component of RNA and nucleoproteins (Vance *et al*. 2003). The acid soils occupy about 39.5 million square kilometres of area in the world, which happens to be about 25.9 per cent of the total geographical area. Out of the total cultivatable area (141 m ha) in India, approximately 49 m ha of land suffers from soil acidity. Out of49 m ha area, 25.9 m ha area has pH less than 5.6, whereas 23.1 m ha has pH ranging between 5.6 to 6.5 (Sharma and Sarkar 2005).

Barring the situation around neutral pH (6.5-7.0 ±0.5), phosphorus availability to plants is a major constraint in both acid and alkaline soils; its average efficiency being 10-20 per cent. In case of acid soils, much of the applied phosphorus may react with Fe and Al ions *(existing in insoluble and exchangeable forms)* thereby, getting precipitated/ fixed as Fe and Al hydroxyl phosphates and thus becoming unavailable for plant use. In alkaline soils, much of it may react with Ca^{2+} ion *(existing in above forms)* thereby getting precipitated as Ca hydroxyl phosphate and turning, out of bounds, for plant use (Brady 2002). In both the above situations, the concentration of P in soil solution is in the micro-molar range; besides, P diffuses slowly in most soils. Hence, depletion of P in the root zone commonly limits further uptake of P by existing roots and potentially, by the plants as a whole.

A number of approaches such as liming, sub-soil placement, application of P in splits and dipping of seedlings into soluble P slurry, etc. all aimed at increasing phosphorus use efficiency have been developed both in India and abroad, but unfortunately, none of the above strategies is equally effective under different situations. Therefore, there is an urgent need to attempt some alternative approach to tackle the problem of low phosphorus use efficiency, especially in acid soils. The majority of Himalayan farmers are small and marginal. They are unable to apply chemical fertilizers in recommended amounts because of their low purchasing power, small and scattered land holdings, remoteness, rainfed/ subsistence nature of farming and lack of awareness about new technologies. Phosphorus is the costliest fertilizer due to which the farmers apply only a nominal amount to their crops due to obvious reasons.

In the Indian Himalaya, the most of the soils come under acid soils which represent about 33 per cent of cultivable land in the various Himalayan States. About 75 per cent of the total rainfall occurs during just four months of the year (June to September). Unfortunately, most of the rainwater gets wasted by as excess run-off in streams, rivers, etc. carrying along with it the fertile soil and nutrients. Run-off water could be harvested and stored in the farm ponds followed by its judicious utilization, particularly in vegetable crops, which are more remunerative (Singh and Mal, 2014). However, in acid soil, especially of high rainfall regions such as Palam Valley, phosphorus availability is much limited because of the reason that applied phosphorus gradually reacts with Fe and Al compounds present in the soil and consequently, it gets transformed into relatively insoluble compounds *(variscite and strengite*), which are hardly available to plants. Phosphorus and harvested rainwater are costly commodities and therefore, must be used efficiently with the aim of maximum economic returns to the farmers.

The soil is a good habitat for many beneficial microbes, including mycorrhizal fungi. Mycorrhiza biofertilizer (VAM), is an inexpensive and eco-friendly input which is capable of enhancing both P availability and water-use–efficiency of crops. Mycorrhizae belong to kingdom fungi, division Glomeromycota, class Glomeromycetes, order Glomerales and family Glomeraceae. Above fungi are associated with plants either upon root surfaces (*ectomycorrhizae*) or inside root tissues (*endo mycorrhizae*). The VAM fungi are a common member of *endo mycorrhizae*. Vesicular arbuscular mycorrhizal (VAM) symbiosis refers to a mutualistic, symbiotic relationship formed between fungi and living roots of higher plants. Mycorrhizae are associated with plants either upon root surfaces (*ectomycorrhizae*) or inside root tissues (*endo mycorrhizae*).

The VAM fungi are a common member of *endo mycorrhizae*. The VAM symbiosis is characterized by fungal structures inside roots, namely hyphae, arbuscules*(highly branched structures)* and vesicles *(drop-shaped storage organs, not always present).* The VAM fungi receive carbon compounds/ nutritional requirements from host plant roots. In turn, they supply nutrients to the plants (N, P, K, Ca, Cu, Zn, etc), which are absorbed by them from the soils (Lalitha*et al*. 2017).Over 95 per cent of plants, form mycorrhizae. However, members of *Brassicaceae*and *Chenopodiaceae* families do not form the above association. The VAM fungi do so by expanding the surface area of the plant root system by 10 to 1000 fold into the soil through ramifying hyphae, thereby increasing their exploratory area for harnessing especially phosphorus and water (Meena*et al*. 2019).

Above fungi solubilize inorganic forms of P through the release of low molecular weight organic acids *(oxalic, malic acids, etc.)*. Above compounds solubilize insoluble phosphates by lowering soil pH, causing chelation of Fe and Al cations and competing with phosphate ions for adsorption sites on soil exchange complex, thereby releasing P into soil solution for plant use. Further, through secretion of a number of enzymes *(chitinase, peroxidase, cellulase, protease, phosphatase, etc.)*, VAM fungi attack complex organic compounds converting them into simple ones, which can be absorbed and used by fungi/ host plants to meet their energy needs for growth and reproduction (Chen *et al.* 2007). Some workers have reported that combined use of mycorrhizal biofertilizer (VAM) with 75 per cent of soil test based recommended Pdose improved yields and quality of wheat, soybean, maize and okra to the same extent as 100 per cent P_2O_5 application, indicating a saving of 25 per cent fertilizer phosphorus (Suri *et al.* 2011).

Use of mycorrhizal biofertilizer (VAM) may be a good proposition to enhance P use efficiencies of crops. The VAM fungi do so by extending the plant root system into the soil through ramifying hyphae, thereby increasing its exploratory area for harnessing especially phosphorus and water. Above fungi not only partially meet our nutrient requirements of crops but, also confer other associated benefits on plants such as increased resistance to diseases, drought, soil salinity and also enhance nitrogen fixation in legumes. Many workers have reported increased uptake of nutrients (N, P, K, Ca, Mg, Fe, Zn, Cu and Mn) in plants inoculated with VAM biofertilizer under various soil and climatic conditions (Kumar 2010).

The VAM symbiosis often results in altered rates of water movement into, through and out of host plants, with consequent effects on tissue hydration and leaf physiology. Mycorrhizal fungi (VAM), which is an inexpensive and eco-friendly input, is capable of enhancing water-use–efficiency of crops. The VAM fungi do so by extending the plant root system into the soil through ramifying hyphae, thereby increasing its exploratory area for harnessing especially phosphorus and water. Mycorrhizal hyphae penetrate soil pores which are inaccessible to root hairs and thus absorb water which is not available to non-mycorrhizal plants. The higher water use efficiency in mycorrhizal plants might be due to the enhanced ability of roots to absorb soil moisture, thereby maintaining stomata in an open condition.

Enhanced water conductivity is attributed to increased surface area for water uptake provided by fungal hyphae in the soil. VAM fungi improved the capability of root systems to draw water in dry soil, resulting in less water stress to foliage and hence, higher transpiration.

The state of Western Himalaya has favourable soil and climatic conditions for the cultivation of various vegetable crops, which are far more profitable than the traditional cereal-based cropping systems. As such, it is worthwhile that the farmers should divert a part of their land from conventional rice (or maize)-wheat sequence to a profitable and sustainable vegetable-based cropping sequence; One of the crops in the sequence should preferably be a legume crop. The legume crops enhance soil fertility and being rich in protein, help provide nutritional security to the farmers. Garden pea (*Pisumsativum* L.) is an important vegetable crop being very palatable, nutritious and amenable to preservation and consumption in the off-season. Presently, it is fetching a high premium in local and super vegetable markets. The area under pea is increasing rapidly in the state, especially under high and mid-hill zones, leaving behind the most important and major vegetable crop i.e. potato (Suri *et al.* 2011). Above trend is perhaps because of easy availability of high yielding disease resistant varieties of pea.

Conclusion

Though the use efficiency of phosphorus is very low, it has a tremendous role in increasing food grain production. Phosphorus is one of the prime nutrients necessary for the growth of all forms of life on planet earth covering plants, animals and micro-organisms as a structural component of cell constituents *(cell membranes, chloroplasts & mitochondria)* and that of metabolically active compounds. In acid soils, high quantity of Fe and Al compounds restrict the phosphorus use efficiency. Mycorrhiza biofertilizer (VAM), is an inexpensive and eco-friendly input which is capable of enhancing both P availability and water-use–efficiency of crops. The VAM symbiosis is characterized by fungal structures inside roots, namely hyphae, arbuscules*(highly branched structures)* and vesicles *(drop-shaped storage organs, not always present).* The legume crops enhance soil fertility and being rich in protein, help provide nutritional security to the farmers. Garden pea (*Pisumsativum* L.) is an important vegetable crop being very palatable, nutritious and amenable to preservation and consumption in the off-season.

References

Brady, N.C.2002. *The Nature and properties of Soils*. Prentice Hall of India Private Limited, Inc.p 621.

Chen, C.R., Condron, L.M. and Xu, Z.H. 2007. Impacts of grassland afforestation with coniferous trees on soil phosphorus dynamics and associated microbial processes: A review. *Forest Ecology and Management* 255: 396–409.

Cordell, D., Drangert, J.O. and White, S. 2009. The story of phosphorus: global food security and food for thought. *Global environmental change* 19.2 (2009): 292-305.

Kumar, S. 2010. Studies on Vesicular Arbuscular Mycorrhizae (VAM) in meeting phosphorus needs of okra-wheat sequence in Typichapludalf. *Ph.D. Thesis, CSK HPKV, Palampur (HP).*

Lalitha, M., Kumar, K.A., Dharumarajan, S., Balakrishnan, N., Srinivasan, R., Nair, K.M. and Singh, S. K. 2017. Role of vesicular-arbuscular mycorrhizae in mobilization of soil phosphorus. In *Agriculturally Important Microbes for Sustainable Agriculture* (pp. 317-331). Springer, Singapore.

Meena, A.L., Meena, L.K., Kumar, C.G. and Kumar, A. 2019. Mycorrhiza enriched biofertilizers for enhancing plant growth. *Agriallis* 1(4):23-32.

Sharma, P.D. and Sarkar, A.K. 2005. Managing acid soils for enhancing productivity. Natural resource management division (ICAR) Krishi Anusandhan Bhavan-II, Pusa Campus, New Delhi, *Technical Bulletin*, pp. 23.

Singh, R. B. and Mal, S.2014. Trends and variability of monsoon and other rainfall seasons in Western Himalaya, India. *Atmospheric Science Letters* 15(3):218-226.

Suri, V.K., Choudhary, A.K., Chander, G. and Verma, T.S. 2011. Influence of vesicular arbuscularmycorrhizal fungi and applied phosphorus on root colonization in wheat and plant nutrient dynamics in a P deficient acid Alfisol of Western Himalayas. *Communication in Soil Science and Plant Analysis* 42(10):1177-1186.

Vance, C.P., Uhde-Stone, C. and Allan, D.L. 2003. Phosphorus acquisition and use: critical adaptations by plants for securing a non-renewable resource. *New Phytology* 157:423–447.

AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

ROLE OF POST HARVEST TECHNOLOGY IN ORGANIC BASED HORTICULTURAL FARMING

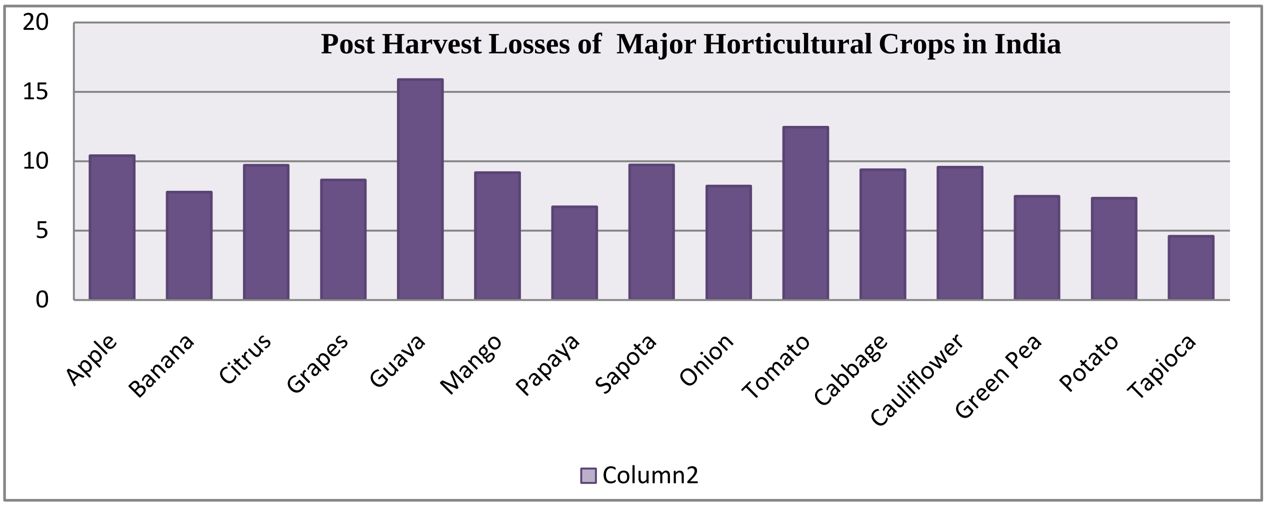
Article Id: AL202060

Kaustubh Das

Department of Horticulture, Institute of Agricultural Science, University of Calcutta, Kolkata, West Bengal-700 019

Email: kaustubh.das@rediffmail.com

Horticultural crops play a unique role in India's economy by improving the income of rural people. Cultivation of these crops is labour intensive, and as such, they generate a lot of employment opportunities for the rural population. Fruits and vegetables are the fastest growing sectors within horticulture. India produces around 111.77 million MTs of vegetables and 57.73 million MTs of fruits, which respectively accounts for nearly 11.90% and 10.90% of the country's share in the world production of vegetables and fruits. India ranks second in the world in both categories. Since fruits and vegetables are highly perishable, efficient Post Harvest Management has become an absolute necessity. It is also important for the effective exploitation of the export potential of fruits and vegetables. The joint effort of R&D institutions, farmers, government agencies and traders has resulted in India emerging as a major producer of fruits and vegetables in the world. But the magnitude of loss in food grains is to the tune of 10% whereas for fruits and vegetable losses are estimated at 35-40% due to improper Post Harvest Management (PHM) (XI Planning Commission). It amounts to a loss estimated at Rs 40,000 crores per year. In India post-harvest losses of fruits and vegetables every year equivalent to the annual consumption of the United Kingdom. So there is a need to have a strong post-harvest infrastructure for post-harvest management of these perishables. Organically grown horticultural products are mainly purchased for their safety and absence of synthetic pesticide residues and other harmful chemicals. So it's must be more important to the management of organic produces after harvesting in such a way, that must be free from human hazards. The aims of organic post-harvest management of organically grown fruits and vegetables for preventing senescence and losses of fruits and vegetables after harvest as well as increasing the shelf life and maintaining the quality of organic horticultural produce for better health.



Source: (CIPHET, Jha *et al* 2015)

Practices for post-harvest management of organic produce

Fruit & Vegetable varieties

Quality for most crops cannot be improved during storage, only maintained, and therefore, any consideration of storage must take into account the importance of variety and preharvest factors. The absence of post-harvest chemical treatments for organic growers, make it even more important that varieties are selected with these factors in mind. Variety selection should also include resistance to post-harvest diseases and physiological disorders.

Maturity at Harvest

Decision associated with harvest maturity and the way the commodity is handled and stored can greatly affect the storage life of even the most long-lived fruit or vegetable. For fully developed fruits, two competing factors often exist. On the one hand, characteristics of the products such as sweetness and flavour that are desired by the consumer increase as they mature and ripen. At the same time, the storability of the products continues to decrease. The outcome of these competing factors is that fruit destined for storage should be harvested earlier than one that is suitable for immediate consumption.

Harvest Handling

The inherent quality of products cannot be improved after harvest, only maintained for the expected window of time (shelf life) characteristics of the commodity. As a general approach for organic growers, the following practices can help you maintain quality. First,

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

harvesting the produces during the coolest time of day to maintain low product respiration. Second, avoid unnecessary wounding, bruising, crushing or damage from humans, equipment or harvest containers. Third, shade the harvested product in the field to keep it cool. By covering harvest bins with a reflective pad, you greatly reduce heat gain from the sun, water loss and premature senescence. Fourth, move the harvested product into a cold storage facility or post-harvest cooling treatment as soon as possible. Fifth, do not compromise the high-quality product by mingling it with damaged, decayed or decay-prone product in a bulk or packed unit. Sixth, only use cleaned and as necessary, sanitized packing or transport containers.

Handling considerations

1. Containers should be clean and should be used only for organically grown produce to avoid any possibility of chemical contamination.
2. High-pressure wash, rinse and sanitize all containers prior to use.
3. Clean containers should be covered to avoid contamination after cleaning.
4. Containers should not have rough surfaces that can damage produce.
5. Damaged or spoiled produce should be left in the field to reduce contamination by decay organisms.

Ethylene

A further factor that must be considered in the storage of fruits and vegetables in ethylene, a naturally occurring plant growth regulator that affects many aspects of growth and development of plants. Ethylene is naturally occurring in plant tissues and is a critical part of normal ripening for many fruits. However, increased ethylene production can occur as a result of disease and decay, exposure to chilling temperatures and wounding. External ethylene will stimulate the loss of quality, reduce shelf life, increase disease and induce specific symptoms of ethylene injury, such as the following:

- Russet spotting of lettuce
- Yellowing or loss of green colour in case of vegetables like cucumber, broccoli, kale, spinach
- Increased toughness in turnips and asparagus spears.
- Bitterness in carrots and parsnips
- Yellowing and abscission (dropping) of leaves in Brassicas.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

- Softening, pitting and development of off-flavour in peppers, summer squash and watermelons.
- Browning and discolouration in eggplant pulp and seed
- Discolouration and off-flavour in sweet potatoes.
- Increased ripening and softening of mature green tomatoes.

Counter measures against ethylene

Avoidance- Removing sources of ethylene

Avoidance of exposure to ethylene begins with careful harvesting, grading and packing to minimize damage to the commodities. In the case of climatic products, it is difficult to reduce the interval levels of ethylene once autocatalytic production has started. Products should be cooled rapidly to their lowest safe temperature to reduce naturally occurring ethylene production and to decrease sensitivity to ethylene.

Ventilation

Ethylene concentrations in the storage environment can be reduced by ventilation with clean, fresh air. However, the fresh air has to be cooled, and increasing ventilation is, therefore, energy-intensive.

Ethylene absorbers, oxidation and catalysis

Ethylene in storage rooms can be lowered by absorption or oxidation. Adsorbers such as activated carbon and zeolites (microporous aluminosilicate minerals) have been available for many years. Ozone will also oxidize ethylene, and its use in slowing down ripening as well as a disinfectant that lowers the mold and bacterial contaminations have been documented.

Modified Atmosphere (MA) and Controlled Atmosphere (CA) storage

MA storage refers to a change in the atmosphere around the product. MA can be developed by-product respiration passively or by active means. CA storage is a subset of MA storage, but as the name suggests, the atmosphere around the product is controlled.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Storage Temperature

The most fundamental post-harvest tool available to the fruit and vegetable grower is temperature control. It is critical to decreasing the temperature of fruit and vegetables as quickly as possible after harvest to slow down their metabolism unless curing is part of post-harvest management.

Methods of cooling are utilized for organically grown vegetables and fruits

Room cooling- An insulated room or mobile container equipped with refrigeration units. Room cooling is slower than other methods. Depending on the commodity, packing unit and stacking arrangement the product may cool too slowly to prevent water loss, premature ripening or decay.

Forced air cooling- Fans used in conjunction with a cooling room to pull cool air though packages of produce. Although the cooling rate depends on the air temperature and the rate of airflow, this method is usually 75 to 90% faster than simple room cooling.

Hydro cooling- Showering produce with chilled water to remove heat and possibly to clean produce at the same time. The use of a disinfectant in the water is essential.

Vacuum cooling- uses a vacuum chamber to cause the water within the plant to evaporate, removing heat from the tissues. This system works well for leafy crops that have a high surface to volume ratios, such as lettuce, spinach and celery. The operator may spray onto the product before placing it into the vacuumed chamber. The high cost of the vacuum chamber system restricts its use to larger operations.

Table 1: Comparison among cooling methods

	Cooling Method				
Variable	Ice	Hydro	Vacuum	Forced-air	Room
Cooling times (h)	0.1-0.3	0.1-1.0	0.3-2.0	1.0-10.0	20-100
Water contact with the product	Yes	Yes	No	No	No
Product moisture loss (%)	0-0.5	0-0.5	2.0-4.0	0.1-2.0	0.1-2.0
Capital cost	High	Low	Medium	Low	Low
Energy efficiency	Low	High	High	Low	Low

Source: Kader & Rolle (2003)

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

Sanitation

Water disinfection should be integrated into every face of post-harvest handling. *Escherichia coli*, *Salmonella*, *Shigella*, *Listeria*, *Cryptosporidium*, *Hepatitis* and *Cyclospora*, are among the diseases and disease-causing organisms that have been associated with fresh fruits and vegetables.

GAP protocols for sanitation of organically grown horticultural produces

- Ensure that contaminated water or livestock waste cannot entre the packinghouse via run-off of drift.
- Wash, rinse and sanitize packing areas and floors at the end of each day.
- Exclude birds and animals, both domesticated and wild (i.e. rodents).
- Field clothes, especially shoes and boots should be kept clean and sanitary, using organically allowable disinfectants, frequent water changes and daily attention to sanitizing all food contact surfaces at the end of each working day.
- Use of disposable gloves should be encouraged for workers on packing lines.

Approved Chemicals for use in the organic post-harvest system

- **Chlorine**: Chlorine is a very common disinfectant that can be added to transport flumes or to produce cooling or washes water. Liquid sodium hypochlorite is typically used, with the pH of the water maintained between 6.5 and 7.5 to optimize effectiveness.
- **Ozone**: Ozone is becoming an increasingly popular alternative to chlorine for water disinfection. Ozone is considered GRAS (Generally Regarded As Safe) for produce and equipment disinfection. Ozone, through its action as an oxidizer, rapidly attacks bacterial cell walls and thick-walled spores of plant pathogens.
- **Acetic acid**: Allowed as a cleanser or sanitizer. Vinegar used as an ingredient must form an organic source.
- **Alcohol, Ethyl**: Allowed as a disinfectant. To be used as an ingredient must form an organic source.
- **Bleach**: Calcium hypochlorite, sodium hypochlorite and chlorine dioxide are allowed as a sanitizer for water and food contact surfaces.

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

- **Detergents:** Allowed as equipment cleaners. Also includes surfactants and wetting agents.
- **Hydrogen peroxide:** Allowed as a water and surface disinfectant.
- **Carbon dioxide:** Permitted for post-harvest use in modified and controlled atmosphere storage and packaging. For crops that tolerate treatment with elevated Co2 ($\geq$ 15%), suppression of decay and control of insect pests can be achieved.

Packaging

Packaging materials, storage containers or bins must be free of synthetic fungicides, chemical preservatives and fumigants. They also must be free of any residue from cleaning and sanitizing. Containers that are to be reused must be of the type that can be thoroughly cleaned prior to use.

Protection

Packages must provide protection for the product against environmental factors such as dust and water, as well as impact and compression bruising and friction injuries that can occur during handling and transport. Cartons must have to stack strength and durability to prevent collapse or crushing while they are on pallets, especially under high relative humidity conditions.

Convenience

Products are packaged in sizes that are convenient for the consumer but may be larger for transport because of the economic scale. The product may be removed from the container and placed in the display as single units or repackaged.

Communication

In addition to advertising the type and source of the produce, information is provided about gross and net package weight, unit size of the product, as well as any declaration of the use of any post-harvest treatments.

Transport

Transportation vehicles should be clean and sanitary. Refrigerated trucks should be used where possible, but at the very least produce should be covered. Refrigerated trucks

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

cannot cool horticultural, and at best can only maintain their temperatures if they have been precooled. Therefore, the refrigeration system should be turned on well before loading and precooled products loaded rapidly.

Techniques which can be undertaken to improve organic horticultural produce during the storage period

- Stores crop in a darkened room.This is especially important for Potatoes, and the light will stimulate solanine production.
- Utilization of Irradiation technologies for value-added organic horticulture produce.
- Do not overload storage rooms.
- Small doses of 2-chloroethyl cycocel help in the retard senescence in a majority of vegetables during storage.
- Application of different waxes & oil emulsion has been found effective in increasing the self-life of various fruits during the storage period,eg-Apple, Kinnow etc. Wax must not contain any prohibited synthetic substances. Acceptable sources include carnauba or wood –extracted wax. Products that are coated with approved wax must be indicated as such on the shipping container.
- Shading should be given for storage structures to reduce cooling load.
- Use of post-harvest UV light therapy technology for extended preservation of fresh organic fruits and vegetables
- Storing the harvested product at 80 to 90% relative humidity maintained room for preventing moisture loss.
- Dehydration is useful techniques to extend the storability of organically grown fruits, vegetables and spices etc.
- Utilization of recyclable and biodegradable packaging material for packaging of organic horticulture produces. eg- biodegradable Styrofoam box , brown paper, Linear low density polyethylene bags, CFB box, Wood fiber box etc.

Conclusion

Fruits and vegetables are perishables since they maintain an active metabolism in the post-harvest phase. The factors causing early termination of their storage life are relatively high respiration rates and senescence, transpiration, and high susceptibility to fungal infection. Therefore, organic post-harvest management practices like storage, dehydration,

Volume 2 – Issue 4
Online ISSN: 2582-368X
www.agriallis.com

value addition and preservation of fruits and vegetables are essential for extending the period of food availability and avoid the problem of contamination of any harmful chemicals along with organically grown fruits and vegetables. However, the technique is purely based on scientific principles. Therefore, it is best recommended that proper & innovative post-harvest techniques should be followed for both fresh & dehydrated organic horticultural produces. This would result in increasing the utility of the commodity & its life after harvest.

References

A. A. Kader, 2005. "Increasing food availability by reducing post-harvest losses of fresh produce, *Acta Horticulturae*, vol. 682, no. 1, pp. 2169–2176.

Food Safety and post harvest handling for organic crops, W. C. Morris, Department of Food science and Technology, Oregon State University, P-4-5.

J. Bachmann and R. Earles, 2000. Postharvest Handling of Fruits and Vegetables, Appropriate Technology Transfer for Rural Areas, Fayetteville, NC, USA,

Organic Farming Practices: Postharvest Handling, Vegetable Research and Information Center, University of California, P-1-9.