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

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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).

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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).

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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

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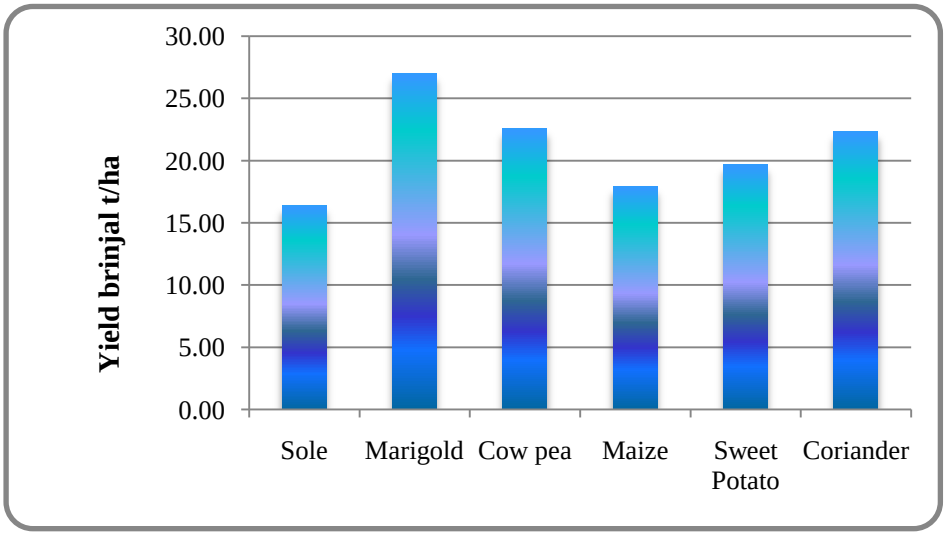
Companion crops gives added income

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.



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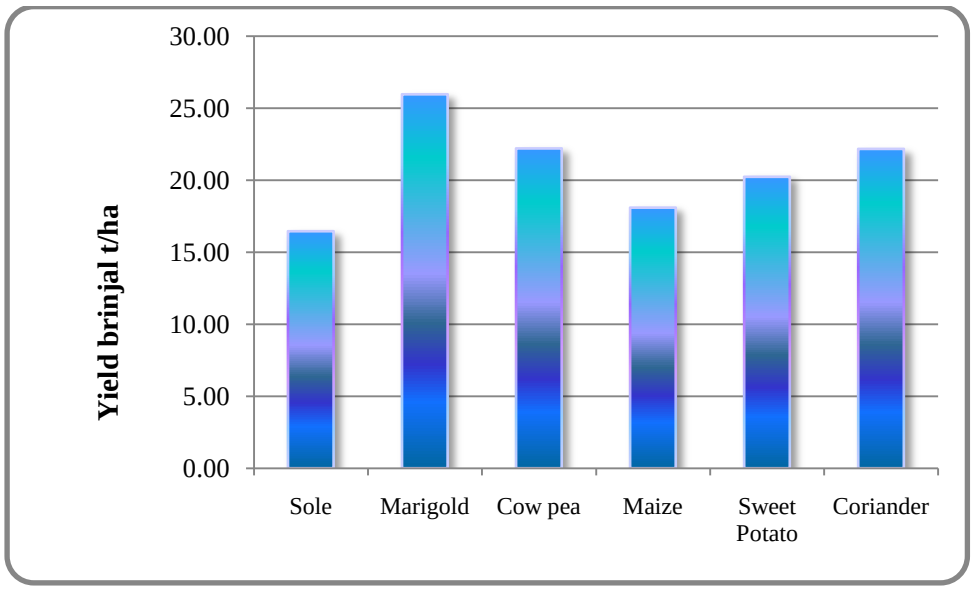
During winter brinjal crop 2017, the yield for sole brinjal was 16.36 t/ha, while for brinjal+marigold combination, the marketable yield for brinjal was 26.99 t/ha, for cow pea+brinjal the yield for brinjal was 22.57 t/ha. However, for maize+brinjal, sweet potato+brinjal and coriander+brinjal, the marketable 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"

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

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