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RESEARCH ARTICLE :

Innovative front line demonstrations in Mau district to enhance brinjal income through integrated pest and disease management

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SUMMARY : The brinjal crop covers largest area and plays an important role in total vegetable production in India. Brinjal crop suffers more from fruit and shoot borer insect pest and disease attack. Due to lack of awareness of farmers, KVK scientists promoted the integrated pest management practices in district for the suppression of pests and diseases. The integrated pest management strategy involving many components was demonstrated through innovative large scale contagious technology demonstration in 20 ha brinjal (local variety) crop area during the year 2014 during *Kharif* season in Mau district in Uttar Pradesh, India. The various production and protection parameters indicated that adoption of IPDM strategies decreased the cost of production without affecting the yield. The IPDM demonstration, insecticides sprays quantity reduction in brinjal was 100 lit. per hectare, respectively as compared to the local check. Adoption of IPDM technology increased the net income over the local check in brinjal local varieties Rs. 2,57,500/ha. In spite of increase in yield of brinjal, technological gap, extension gap and technology index existed. The improved technology gave higher gross return, net return with higher benefit cost ratio as farmers' practices.

KEY WORDS :
Brinjal, Frontline demonstration, IPM, Fruit, Shoot borer, Bacterial wilt

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BACKGROUND AND OBJECTIVES

Brinjal (*Solanum melongena* L.) also known as egg plant or aubergine, is one of the top ten vegetables in the world. It is grown on more than 2 million ha with a production of nearly 33 million tonnes. China is the world's top brinjal grower, accounting for more than half of world acreage and India is second, with about one quarter of the world total. Indonesia, Egypt, Turkey, Iraq and the Philippines are the other major brinjal producing countries. Asia accounts for about 94 per cent of the world brinjal grown area, with about 92 per cent of world output (FAO, 2007). Brinjal is well adapted to high rainfall and high temperatures, and is among the few vegetables capable of high yields in hot-wet environments. It contains nutrients such as dietary fibee, folate, ascorbic acid, vitamin K, niacin, vitamin B6, pantothenic acid, potassium, iron, magnesium, manganese, phosphorus and copper. Now most of the solanaceous vegetables are available throughout the year. However, there is a risk of severe damage by insect pests and diseases. Particularly, the insects that damage these crops range in their ability to reduce yields at different growth stages. Moreover, insects that transmit disease agents, such as whitefly or thrips vectored plant viruses, can also have similar devastating effects on yield. Vulnerability of the solanaceous brinjal vegetable to insect pests and diseases continues to be one of the major factors responsible for the lower productivity with wider fluctuation. Brinjal local variety which is prone to *Leucinodes orbonalis* is considered the main constraint as it damages the crop throughout the year. This pest is reported from all brinjal growing areas of the world including Germany, Burma, USA, Sri Lanka and India. It is known to damage shoot and fruit of brinjal in all stages of its growth. The yield loss due to the pest is to the extent of 70-92 per cent (Reddy and Srinivasa, 2004; Chakraborti and Sarkar, 2011 and Jagginavar *et al*., 2009). The infested fruits become unfit for consumption due to loss of quality and hence, lose their market value. It is also reported that there will be reduction in vitamin C content to an extent of 68 per cent in the infested fruits.

Growers rely heavily on chemical pesticides to protect their eggplant crop. For instance, farmers in certain areas of Philippines spray chemical insecticides upto 56 times during a cropping season. The total quantity of pesticide used per hectare of egg plant was about 41 lit of different brands belonging to the four major pesticide groups (Orden *et al*., 1994). In Bangladesh, some farmers spray about 180 times during a cropping season (SUSVEG Asia, 2007). Misuse of pesticide has adverse effects on the environment and human health and also increases the cost of production. The share of the cost of pesticide to total material input cost was 55 per cent for egg plant compared with cabbage (49%) and tomato (31%) in the Philippines (Orden *et al*., 1994) and accounted for 40–50 per cent in Bangladesh (SUSVEG Asia, 2007). Many farmers refrain from growing egg plant due to the cost of pesticides.

Brinjal being a vegetable crop, use of chemical insecticides will leave considerable toxic residues on the fruits. Beside this, sole dependence on insecticides for the control of this pest has led to insecticidal resistance by the pest. Hence, use of organic amendments, plant products and microbial origin insecticides can be the novel approaches to manage the pest. Considering the changing scenario in demand of vegetables, there is further need for increasing productivity and profitability along with the quality vegetables production in the country. There is a potential to increase production of solanaceous vegetables by using best production practices and right combination of input at right time to bridge the yield gap between demonstration trials and farmers' field. Several technologies and management options are developed for protecting the crops, that can significantly reduce the losses due to insect pests, but adoption of these technologies by the farmers has been far less than anticipated.

Though IPDM developed long back, the technological knowledge and adoption rate was low in the minds of brinjal farmers. The improved technology package was found beneficially attractive, yet adoption levels for several components were low, hence, emphasizing the need for better dissemination innovative large scale 50 acres IPDM front line demonstration was planned and implemented successively during the year 2014 (*Kharif* season) to diffuse and influence the practices of IPDM technology on yield, cost of plant protection, quantity of pesticides consumption and frequency of pesticides sprays. Realizing the importance of extending these technologies for management insect pests in brinjal vegetable crop at farmers' level, frontline demonstrations (FLDs) were conducted to show the productivity potential and profitability of need based plant protection.

RESOURCES AND METHODS

Large scale integrated pest and disease management demonstrations were conducted with brinjal local varieties in a contagious area of 50 acres during the year 2014 in Mau district of Uttar Pradesh during *Kharif* season. The 50 acres in the year of 2014 in fifty different locations of the district involving 50 farmers irrespective of their farm size and brinjal crop area. The selection of blocks, village and farmers were made purposively looking the criteria of continuity of brinjal crop in that area, brinjal crop pest and disease population and lack of IPDM package of practices.

Materials distributed to each farmer:

– $CuSO_4$	– 5 kg
– Lime	– 5 kg
– Pheromone traps	– 16 pc
– Pheromone lure	– 24
– Proclaim	– 80 g

– Spinosad – 80 ml
– Cabriotop – 240g
– Natio – 120g
– Neem oil – 1lit

Before conducting demonstrations the actual existing field problems of brinjal growing farmers and technological gaps in brinjal production were identified with care through extension methods like survey, group discussion, secondary data and kisan gosthies. During the conduct of these resource inventory techniques farmers were facilitated to express the constraints in the production of brinjal crop over the years. Due care was taken to listen and consider the field experiences of progressive brinjal growers, medium to big land holders and categories of tribal farmers and gender. The components of IPDM demonstration in brinjal were summer ploughing, sowing of insecticides treated seeds, soil drenching with copper oxychloride (blitox), monitoring of pest load through pheromone traps, insecticidal sprays with emamectin benzoate (proclaim), spinosad at vegetative stage, need based application of neem and need based sprays of chemical pesticides, excluding the release of trichogramma egg card and HNPV. With all these farmers' practices collected the data on yield gaps between potential yield and demonstration yield, extension gap, technology index, quantity of insecticides used and reduction of plant protection were the parameters observed to analyze the impact of IPDM in enhancing the productivity in turn net income from brinjal cultivation. The insect pest population level and stage of crop was considered to impose the IPDM components. Traditional calendar based pest management practices were considered as local check for comparative study. Technological gap, extension gap and the technological index were calculated using the following standard formula (Samui *et al*., 2000).

$$\textbf{Technology gap} = \textbf{Potential yield} - \textbf{Demonstration yield}$$

$$\textbf{Extension gap} = \frac{\textbf{Demonstration yield} - \textbf{Farmers}}{\textbf{Local check yield}}$$

$$\textbf{Technology index} = \frac{\textbf{(Potential yield - Demonstration yield)}}{\textbf{Potential yield}} \textbf{x100}$$

OBSERVATIONS AND ANALYSIS

The data presented in the Table 1 revealed that the yield difference between potential, demonstration and local check attributed for the fact that the brinjal was grown in the irrigated situations during *Kharif* season. The study revealed that there was much difference in the yield of brinjal both in the demonstration and local check. The per cent increase in the yield of brinjal was 50. These results indicate that the IPDM technology had an impact on brinjal yields. The technology gap in the yield of brinjal was 5.0 t/ha (Table 1). The probable reason for this gap is lack of awareness in farmers. Generally as seen in the demonstration fields' brinjal was cultivated in medium to deep red soils. The extension gap was 20.0 t/ha in brinjal local varieties. The data shows that there was much extension gap in the yield levels, however, some more efforts are yet to be intervened to convince the advantages and effectiveness of IPDM technologies. The knowledge upgradation on eco-friendly farmer friendly and cost effective technologies, time of proper use of IPDM inputs and accessibility of IPM inputs in time may definitely create positive impact on the enhanced yields of brinjal and also influence in the reduction of brinjal pest and disease load. Spinosad and emamectin benzoate were effective in suppressing the fruit infestation by brinjal shoot and fruit borer (Anil and Sharma, 2010). Better control of lepidopteran pests on cotton with spinosad (Dandale *et al*., 2000). The IPDM technologies demonstrated eventually lead the farmers to discontinue the old practices with adoption of demonstrated practices. The technology index showed the feasibility of the evolved technology at farmers' fields. Female pheromone attracts the male brinjal shoot and fruit borer. The pheromone lure could be used in catching male adults to control this pest population in eggplant fields (Mazumder and Khalequzzaman, 2010). The lower the value of technology index the more shall be the feasibility of the technology. The technology index of brinjal was 16.6 per cent. Considering these data it seems that the technology is 16.6 per cent feasible. However, in view of the ecological safety and net economic benefits

Table 1: Productivity, yield gap and technology index of IPDM demonstration of brinjal

Average yield (t/ha) under potential	30.0
Average yield (t/ha) under demonstration	25.0
Average yield (t/ha) under local check	12.5
Per cent increase in yield	50.0
Technology gap (t/ha)	5.0
Extension gap (t/ha)	20.0
Technology index (%)	16.6

Table 2: Economics of IPM demonstration

Increased yield (Extn gap over local check) (t/ha)	12.5
Average price of brinjal (Rs./t)	20000
Additional income due to increased yield (Rs./ha)	2500000
Amount saved in plant protection chemical over local check (Rs./ha)	7500
Net income gained (Rs./ha)	257500

(Table 2) the technology is much feasible as IPDM technology includes ecologically safer pest management practices.

Although, the reports on efficacy of this pesticide are not found on brinjal jassids, most related compound avermectin provided moderate control of jassids on brinjal in West Bengal (Ghosh *et al*., 2004). Spinosad was characterized in 1988 and consists of a mixture of related spinosyn toxins, principally spinosyn A and D. It has very good contact and stomach activity. It shows no effects on the predatory insects such as lady bird beetles, lacewings, big eyed bugs and shows reduced activity against parasitic wasps and flies. Because of low applicator's risks, it was recommended as an IPM tool (Nowak *et al*., 2000).

Different parts of neem are known to contain over 40 bitter principles belonging to the terpenoid, triterpenoid, limonoid and flavanoid group of natural products, the most well known are the azadirachtins. The Central Insecticides Board of India has approved the registration of 300 ppm oil based and 1500 ppm kernel based neem formulations (Akhtar, 2000). Neem oil formulations have been tried as seed dressing, seed coating, seedling bare root dip treatment and soil drenching. Indian farmers without the knowledge of the chemical constituents have been using neem products as a traditional method of pest control for centuries. The increasing interest in neem in recent years has resulted in the development of cheap, safer and eco-friendly nematicides and pesticides. Neem seed constitutes the basic raw materials for neem products. The additional income due to increased yield and saving on plant protection chemical in brinjal was Rs. 2,50,000/- and Rs. 7500/- per ha, respectively (Table 2). These data showed that the adoption of IPDM technology increased the net income over the local check in brinjal (Rs.2,57,500 per ha). The data showed that per cent reduction in cost of plant protection was 42.85 (Table 3). The data on impact of lucid lure pheromone traps on the level of sucking pests incidence (Table 4) in brinjal showed reduction in number, hence, it can be concluded that physical control reduces chemical load and also the data on number of sprays (Table 5) in brinjal showed reduction in number, hence, it can be concluded that IPDM technology reduces usage of plant protection chemicals on brinjal production system. Farmers around the world benefitted from this technology through increased productivity, convenience and time savings. The vast majority of farmers using brinjal globally are small holder farmers. The economic, environmental and social benefits derived from adoption of this important tool have very positive implications for the farmers, their surrounding communities and the future of agriculture. In brinjal production system, IPDM technology was found as imperative for common pest problems. The adoption of IPDM technology increased the net income. There is need to adopt multi prolonged strategy that involves enhancing income of brinjal tribal farmers through effective management of insect pest with the adoption of IPDM technology. Hence, the technology may be

Table 3: Cost of plant protection in brinjal IPM demonstration

Cost of plant protection under demonstration (Rs./ha)	10000
Cost of plant protection under local check (Rs./ha)	7000
Per cent reduction in cost of plant protection	42.85
Economic extension gap	-7500

Note: Negative digits of economic extension gap can be read as saving on plant protection chemicals

Table 4: Impact of lucid lure sex pheromone traps on the level of sucking pests incidence

Sr. No.	Name of the month	Period	Effect of sex pheromone traps on the mortality of insects/trap
			Number of *Leucinodes orbonalis* adult moths/trap
1.	July	1st	5
		3rd	4
2.	August	1st	8
		3rd	3
3.	September	1st	6
		3rd	6
4.	October	1st	7
		3rd	5
5.	November	1st	5
		3rd	0
6.	December	1st	0
		3rd	0

Table 5 : Number of sprays to brinjal IPM demonstration

1.	Number of sprays under demonstration	12
2.	Number of sprays under local check	20
3.	Per cent reduction in sprays	40
4.	Extension gap	-8

Note: Negative digits of extension gap can be read as reduction in number of plant protection chemical sprayed in one acre area

popularized to mitigate the extension gap.

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