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Integrated Management of shoot and fruit borer of brinjal on farmers' fields at Hathras district of Uttar Pradesh

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Abstract:
Brijal (*Solanum melongia* L.) is an important vegetable crop of India. India is a leading producer in the world and during 2018-19 the country produced 15.5 lakh tones of from an area of 11.25 lakh hectares. Brinjal is cultivated in most of the states in India. however a state namely Uttar Pradesh, Punjab, Haryana is also major brinjal producing state in india.The districts of these state contributes 45% to production of total production .India produces 30% brinjal of the world production. In general, average productivity of brinjal continues to low (45 t/h) mainly due to heavy infestation of shoot and fruit borer. The shoot and fruit borer is the most destructive pest of brinjal. This result in total loss of affected production and quality of brinjal. Therefore, present study was under taken to assess the technology for management of shoot and fruit borer management. On farm trial were conducted at 25 farmer's field to assess the shoot and fruit borer management technologies comprising summer ploughing+neem cake 550kg/ha+soil application of carbofuran 1 kg a.i. at the time of transplanting around the base of the plant improved (variety Pusa Puple Long)+ selection of good seed+seed treatment (Imidacloprid 17.8 sl@3 ml/lit. of water)+3 drenching (carbofuran @3 ml/lit of water during kharif season of 2017-18 and 2018-19in clay irrigated condition. Need based spray of animal origin insecticides cartap hydrochloride @500gm a.i./ha.conducing with reproduction phase. The incidence of shoot and fruit borer was recorded only 12.57 per cent under integrated pest management as against 45.47 per cent recorded under farmers practices. The production of brinjal under integrated pest management technologies' ranged between 45.25 to 55.5 t/ha with mean yield of 50.37 t/ha as against a yield range between 30.23 to 40.35 t/ha with mean of 35.29 t/ha under farmers practice. The additional yield under integrated pest management technologies over local practice ranged from 15.02 to 30.15 with mean of 15.02 t/ha. In comparison to local check, there was an increase to 41.5, 30.24 and 35 per cent in production of brinjal under improved technologies in respective years. The higher productivity might due to effective management of shoot and fruit borer of brinjal. The higher yield obtained under improved technologies as compared to local check due to effective management of shoot and fruit borer of brinjal.

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Introduction:

Brijal (*Solanum melongia* L.) is one of the most popular and widely grown vegetable crops of India. In India, it occupies an area of about 7.79 lakh hectares producing over 172.3 lakh tones with the productivity of 20.9 tons/ha. In Uttar Pradesh, the crop is cultivating to an extent of 91.27 thousand hectares with a production of 19.57 lakh tones and productivity of 21.4 tons/ha. (Anon., 2017). Hathras district situated in south western semi-arid eco-system (Zone - IV) of U.P. There are 4- sub-divisions and seven development blocks in district. The small and marginal farmers are growing tomato, cucurbits, brinjal and onion as main vegetables crops of the area. Although area (575 ha), with an annual production 2755 tones and productivity 450 q/ha under brinjal crop is suffering from large number of diseases and insects. Among them shoot and fruit borer caused by losses significantly cause substantial yield loss in India and worldwide (Muhammad Abdullah Shaukat, Ahmad Manan Mustafa, Ahmad, Sohail Maqsood, Umer Hayat, Farwa Mustafa Muniyappa,1988, Singh R, Singh TK, Shah Sattar MA,2011, Singh R, Devjani P, Singh TK,2009b, Shobharani M, Nandihalli BS.2004, Meena G, Pachori RK, Panse R.2012).

Brinjal cannot be grown in plains during June-September owing to high temperature and stagnation of water in fields during rainy season. But, it can be grown successfully under rain fed conditions in well drained soils of the undulating terrain. Thus, sloppy lands and precipitation mainly received during June to September provide congenial conditions for growing rainy season brinjal in certain areas and it can be a boon in supplementing the income of small and marginal farmers of the regions. Though rainy season brinjal cultivation is becoming increasingly attractive for cash generation in the undulating terrain of this agro climatic zone, but, the productivity of crop is very low due to several production problems like high mortality of seedlings at nursery stage, high incidence of phomopsis blight diseases and non availability of suitable varieties and insectides for the rainy season, thus, limiting brinjal cultivation on a commercial scale. (Rashid MH, Mohiuddin M, Mannan MA.2004)

While assessment of integrated modules (IPM) for management of shoot and fruit borer of brinjal with promising cultivars for rainy season in terms of good yield and comparatively less damage from leaf curl virus. Uses of tolerant/ resistant varieties for effective management of shoot and fruit borer insect for rainy season production. Though there are many reports on varietal selection, appropriate time of planting and shoot and fruit borer management measures for rainy season brinjal, these constraints still prevail in the farmer's field. For promoting rainy season brinjal production as a remunerative enterprise in the undulating terrain, availability of varieties tolerant to heat, rains and shoot and fruit borer has became major constraint. Majority of brinjal growers purchase seeds from the market with no certainty of good performance. To provide alternative option of IPM suitable modules to the vegetable growers, the experiment was conducted to assessment of different proven technologies with two shoot and fruit borer resistant varieties of brinjal especially recommended for rainy season cultivation against the variety (Kashi Sandesh) cultivated by most of the farmers during rainy season.

Material and Methods

The present study was carried out by the Krishi Vigyan Kendra, Hathras, C. S. Azad University of Agriculture & Technology, Kanpur (U.P.) during rainy seasons of two consecutive years 2017-18 to 2018-19in the farmers fields of 05-villages of Sasni block of the district in agro-climatic zone - IV of Uttar Pradesh to 2017-18 in irrigated condition on medium soils with low to medium fertility. Each demonstration was conducted in an area of 0.1 ha and 0.1 ha area adjacent to the demonstration plot

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as farmer's practices *i.e.* prevailing cultivation practices served as local check. All 25-on farm testing trails demonstrations in 2.5 ha area was conducted. The experiment was arranged in a randomized block design (RBD) with 5 replications, farmer as replication.

The IPM technologies modules were T1(check-1)= Farmers practice (Variety-Aruna + indiscriminate use of insecticides), T2 (technology-2)= Variety Kashi Sandesh + Seed treatment with Imidacloprid, netting of nursery, spray 4% NSKE minimize shoot and fruit borer population, Pre transplanting application of Imidacloprid @ 0.3 ml/lit in nursery protects the newly planted crop from borer infestation.(source of technology IIVR,Varansi,year of technology,2009-10) and T3 (technology-3)= Variety Pusa hybrid-9+ Raise Marigold (Tall African variety golden age bearing yellow and orange flowers) nursery 15-20 days before brinjal nursery+ One week after germination of seeds, spray the seedlings with (Imidacloprid 200 SL @ 0.3 ml/l or Emamectin benzoate 5 wg @ 1.0 g/l)+Apply Neem cake 250 kg/ha ridges at the time of preparing land+ Dip the roots of seedlings (do not dip the foliage as it may cause burning of leaves) with Imidacloprid 200 SL @ 0.3 ml/l for 5 minutes. Fifteen days after planting spray Emamectin benzoate 5wg @ 1.0 g/l for borer control+ Destroy borer affected plants as soon as the symptoms appear in a few plants to minimize their spread (source of technology, IIHR,Bangalore, year of technology,2009-10)

All these IPM technologies modules were used in brinjal crop for shoot and fruit borer management. The seed sown in the raised nursery beds on 6th of June 2017-18 and 2018-19. After 25 days, these seedlings were transplanted in the experimental plots on 1st July of 2017-18 and 2018-19. The individual plot size was 15 m^2 (3 X 5 m) per treatment. Seedlings were transplanted at a spacing of 45 cm on ridges spaced at 45 cm apart, counting a total of 60 plants per plot. The experimental plots were interspaced at 1.2 m. Each cultivar was given the same management treatments *i.e.* fertilization, irrigation, weeding and different IPM technologies modules against shoot and fruit borer of brinjal. Compost @25 tons/ha and NPK@ 50:60:60 kg/ha was applied as basal dose during field preparation and additional dose of nitrogen @70 kg/ha was applied as top dressing in two equal splits at 30 and 50 days after transplanting. Irrigation was applied as and when necessary.

Normal cultural practices were adopted to raise the crops successfully. The observations in each plot every year to record the on number of fruits/cluster, fruits/plant, average fruit weight, marketable fruit yield, non-marketable fruit yield and plant stand (survivability) at harvest and the yield was recorded on plot basis. The shoot and fruit borer infestation and severity were recorded 75 days after transplanting. The severity was rated in 3 grades, 1- mild symptom (light foliar yellowing), 2-moderate symptoms (light foliar yellowing, curling and slight plant stunting) and 3-severe symptoms (very severe plant stunting, leaf size reduction, and yellowing). The mean data for all observations over two years were pooled and statistically analyzed following standard procedure.

Materials for the present study with respect to OFT was on following

T1-Farmers practice- Variety-Aruna + indiscriminate use of insecticides

T2-Variety Pusa hybrid-9+ Seed treatment with Imidacloprid, netting of nursery, spray 4% NSKE minimize borer population, shoot and fruit borer incidence + Pre transplanting application of Imidacloprid @ 0.3 ml/lit in nursery protects the newly planted crop from borer infestation, Source of technology,IIVR,Varanasi,2015-16

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T3-Variety, Kashi Sandesh + raise Marigold + One week after germination of seeds, spray the seedlings with (Imidacloprid 200 SL @ 0.3 ml/l or Emamectin benzoate 5wg @ 1.0 g/l)+Apply Neem cake 250 kg/ha ridges at the time of preparing land+ Dip the roots of seedlings (do not dip the foliage as it may cause burning of leaves) with Imidacloprid 200 SL @ 0.3 ml/l or Emamectin benzoate 5wg @ 1.0 g/l g/l for 5 minutes. Fifteen days after planting spray Imidacloprid 200 SL @ 0.4/ml + Destroy borer affected plants as soon as the symptoms appear in a few plants to minimize their spread

In OFT demonstration plots, critical inputs in the form of quality seed and treatment, farm manure, balanced fertilizers and agro-chemicals were provided by KVK. For the study, assessment and refinement of different IPM technologies for suitability at local or microclimatic situation so that these technologies would be further accepted or rejected or refined as per feedback of technological and farmers. The suitable modules were assessed for large scale demonstrated among more farmers for diffusion and adoption of technology for management of shoot and fruit borer of brinjal. The technological gap, extension gap and technology index were calculated as suggested by Samui, *et al* .(2000).

Technology gap = Potential yield- Demonstration yield

Extension gap = Demonstration yield-Farmers yield

$$\textbf{Technology index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

Results and Discussion

1. Effect on Brinjal yield, growth parameters and Insect

1.1 Brinjal fruit yield

The yield of brinjal under different integrated shoot and fruit borer management technologies ranged from 120.5 to 282.5 q/ha with highest average yield 280.3 q/ha. The cultivation of brinjal with shoot and fruit borer technologies, the yield ranged from with mean average 235.2 to 240.1 q/ha,(average mean (237.6 q/ha) with borer resistant variety Kashi Sandesh with IPM technology-2, while in technology-3 with resistant variety Pusa Hybrid-9, 275.5 to 282.2 q/ha with an average mean yield (280.3 q/ha) during 2017-18 to 2018-19 (Table-1) as against a yield ranged 120.5 q/ha to 122.2 q/ha with a mean of 121.8 q/ha recorded under farmer's practices (technology-1, local check) in an average mean of both the years. This finding is in corroboration with the findings of Alam SN, Rashid MA, Rouf FMA, Jhala RC, Patel JR,2003, Alam MA, Rao PK, Rao BHK; 1982)

The additional brinjal fruit yield under technology-2 over local check ranged from 111.8 to 114.8 q/ha with a mean of 113.3 q/ha. In comparison to local check there was an increase of 95.2 % in yield of brinjal with technology1 in both the years' means. The increased brinjal fruit yield with variety Kashi Sandesh + IPM technology-2 was mainly because of use improved borer resistant variety and IPM technology. While the additional yield of brinjal fruit over local checked ranged from 155 to 160 q/ha with a mean of 157.5 q/ha in borer resistant variety Pusa hybrid-9 + IPM technology-3 for borer

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management in mean of both the years. The increased in comparison to over farmer practice was 130.9% in both the years mean. The overall performance among technologies, the highest yield and increased over farmers check was in Technology-2**.** This finding is in corroboration with the findings of Alam SN, Rashid MA, Rouf FMA, Jhala RC, Patel JR, 2003, Raina J, Yadav GS, Sharma SS.2016, Niranjan RF, Devi M, Philip Sridhar R, 2017)

1.2. Effect on growth parameters of Brinjal

Data on other parameters *i.e*. number of fruits/plant and weight of fruit (gm) of brinjal was also found increased in both the technological intervention over farmers' practices (Table 1). The average number of tomato fruits 36 and 46.5 with an increased 17% and 51.1% in an average mean of both the years respectively, in technology-2 and technology-3 over farmer practices 30.7. The average mean weight of fruit was also recorded an increased trend 134.8 (g) and 151.1 (g) with increased 11.3% and 24.9 % over farmers practices (121 g). The highest performance in all parameters of brinjal was recorded on technological intervention-2 (T-3). This finding is in corroboration with the findings of Taley YM, Nighut US, Rajurkar BS, 1984, Rani AT, 2013)

1.3 Decreased in shoot and borer (%) of brinjal

The significant data on highest decreased in shoot and fruit borer of tomato were recorded 89.1% and 96.5% in both the years mean over farmers' practices, respectively in technology-2 and technology-3. The incidence of borer was recorded least 2.3% in technology-2 while 7.1% in technology-1 while borer infestation was highest 66.8% in farmers practice on the mean basis of both the consecutive year (Table 1).

2. Economics analysis

2.1 Net Return

The economic viability of improved technologies over traditional farmer's practices was calculated depending on prevailing prices of inputs and outputs costs (Table-2). It was found that cost of production of brinjal varied from Rs.43000 and 45000 to 46000 and 47000/ha with an average of Rs.44000/ha and Rs. 47500/ha of improved technologies as against the variation in cost of production from Rs.35000 to 37000/ha with an average of Rs.36000/ha in local check in both the years. The improved production technologies registered an additional cost of production ranging from Rs. 8000/ha and 11000 with a mean of Rs.8000/ha and 11500/ha over local check, respectively, technology-2 and technology-3. The additional cost incurred in the improved technologies as compared to farmer's practices was mainly due to more costs involved in inputs of technologies. Cultivation of brinjal under improved technologies gave higher net return ranged from Rs.145160 to 159085 /ha, with a mean value of Rs.152125.5/ha and Rs. 174400 to 193420/ha, with a mean value of Rs. 183910/ha as compared to local check mean value of Rs. 64135/ha. There was an additional net return of Rs.113000 to 126550/ha and Rs.93380 to 109382.5/ha in the years respectively, technology - 2 and technology-3 under demonstration plots. The improved technologies also gave higher benefit cost ratio 4.4 to 4.8 compared to 2.7 under local check in the corresponding seasons in technology-2 and 3, respectively. This may be due to higher yields obtained under improved technologies compared to local check (farmers practice). This finding is in corroboration with the findings of Lal BS, Ahmad SQ, 1996. Alpuerto AB, 1994)

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The results from the current study clearly brought out the higher potential yield and borer insect resistant varieties as well as improved integrated pest management technologies in enhancing brinjal production, reducing highest infestation of borer insect and economic grains in Hathras district condition of Uttar Pradesh.

2. 2 Technology gap

The technology gap in the demonstration Brinjal yield over potential yield were 344.5 q/ha in Pusa Hybrid-9 and 387.4 q/ha in Kashi Sandesh with an average on both the years 365.9 q/ha in both the varieties and its respective technologies for shoot and borer management in brinjal (Table 3).The technological gap may be attributed to the dissimilarity in the soil fertility status and weather conditions

2.3 Extension gap

The highest extension gap of 140.4 q/ha was recorded in brinjal variety Kashi Sandesh and the lowest was observed in 135 q/ha in variety Pusa hybrid-9 with its IPM. This emphasized the need to educate the farmers through various means for the adoption of improved brinjal production technologies to reverse this trend of wide extension gap. More and more use of latest production and IPM technologies with high yielding and resistant varieties will subsequently change this alarming trend of galloping extension gap. The new technologies will eventually lead to the farmers to discontinue the old technology and to adopt new technology (Table 3).

2.4 Technology Index

The technology index shows the feasibility of the evolved technology at the farmer's fields and the lower the value of technology index more is the feasibility of the technology. The average technology index was 58.5 per cent, while 59.6% maximum technology index was in technology-3 with Kashi Sandesh during 2017-18 to 2018-19 (Table 3).

Conclusion

The results were found highly significant increased in yield and growth attributes of brijal on resistant varieties of borer with integrated pest management technologies and reduced insect infestation as comparison to farmer practices. The high yield and borer resistant varieties with insect management technologies were found the main factors to give the high achievement on brinjal cultivation while farmers were unaware about these varieties and insect management practices. Farmers were convinced due to performance of technologies and accepted the ones but farmers want availability of new technologies inputs timely at local market. These technologies further could be taken under front line demonstration programme for large scale adoption horizontal and vertical spread among brinjal grower of the district.

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