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Insect-pest and disease management in onion with farmer's participatory approach in Sagar district of Madhya Pradesh

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Abstract
Onion (*Allium cepa*) is a valuable cash vegetable and spice commodity consumed all over the world. Cultivation of Onion depends on many biotic and abiotic factors. Due to climatic variability heavy infestation of thrips and Stemphylium blight disease occurred in Onion in Madhya Pradesh. Apart from this poor management and imbalance fertiliser application resulted bulb rot imparts to about 15- 30% losses during storage of different fungi. The average of the results of on farm trails at 55 locations showed that the population of thrips controlled 80 per cent and stemphilium blight disease managed by 66.9 per cent and yield increased by 25.5 per cent (145 q to 182 q/ha) by the adoption of IPM package (The seedling treatment with *Trichoderma viride* @ 10 gm/lit of water, installation of blue sticky trap @ 150 /ha, spray of Spinosad at 40-45 day after planting followed by a spray of tebuconazole at 55-60 days). The additional cost of IPM in onion Rs 7000 per hectare given Rs. 29600 per hectare as additional returns. By the adoption of proper management fungal infection reduced from 63.0 to 30.0 per cent (52.1%) and increased shelf life of Onion in storage.

Keywords: Onion, thrips, stemphilium blight, IPM, post-harvest management

Introduction
Onion (*Allium cepa*) is a valuable cash vegetable and spice commodity consumed all over the world and has nutritive as well as medicinal values like controlling bleeding piles, cold cough, bronchitis influenza and disorder in the urinary system[9]. It is a good source of minerals, vitamins, Polyphenol and a number of phyto nutrients. India ranks first in terms of the area under onion cultivation in the world and second largest producer of onions after China, producing 1.6 million MT annually [5]. There are three main seasons of onion production namely-kharif, late kharif and Rabi. Kharif produce imparts 15-20% production and is available in the market from October to December, whereas the late kharif produce which comes in the market from January to March accounts for 20-25% production followed by the Rabi crop which is harvested in April to June which accounts for 60-65% production. The Rabi season onion is only kept for storage till October -November due to its better storability and is made available steadily for domestic as well as international markets. The onion producing states in India includes mainly, Maharashtra, Karnataka, Gujrat, Bihar and Madhya Pradesh. Onion is a commercial crop which is grown in a 21000 ha area in the Sagar district.
Cultivation of Onion depends on biotic and abiotic factors [3]. Increase in the frequency of climate extremes, especially temperature and rainfall, are likely to influence the distribution, establishment and epidemiology of insect-pest and diseases in various crops. Due to climatic variability heavy infestation of thrips and Stemphylium blight disease occurred in the Onion. Apart from this poor management and imbalance fertiliser application *i.e.* application of excess nitrogen in standing crop resulting high infestation of fungal diseases in storage. The onion stored for long period up to about eight to ten months after treating accurately at its pre and post- harvest stages. About 35-40% onion is lost due to damage caused by storage diseases. The fungal bulb rot imparts to about 15- 30% losses during storage of different varieties. There are diverse fungal pathogen species like *Aspergillus* spp, *Penicillium* spp, *Alternaria* spp, *Fusarium* spp, *Rhizopus* sp., C*olletotrichum* spp., *Pseudomonas* spp., *Lactobacillus* spp., *Erwinia* spp and *Botrytis* spp which attacks onion bulb during the post-harvest storage period. Amongst all *Aspergillus* spp. (Especially *A. niger*) is the most virulent fungal pathogen in the field and during the post harvest storage. In general, the losses due to a reduction in weight,

sprouting and rotting (decay) were found to be 20-25, 4-5, and 10-12% respectively [8]. Onion suffers from many diseases from pre harvest to post harvest period. They survey conducted at the international level revealed that about 35-40% onion is lost due to damage caused by different diseases [6].

Materials and Methods

Keeping the infestation of above insect-pest and diseases, the present study was conducted by Krishi Vigyan Kendra, Sagar during Rabi season of 2014 and 2017 in onion growing areas of the Sagar district of Madhya Pradesh at 55 locations with the farmers participatory approach. The soils of the site were medium fertility status (low in available nitrogen, medium in available phosphors and potash). A list of farmers was prepared from group meeting and specific skill training was imparted to the selected farmers regarding different aspects of recommended production and protection technologies. Difference between technological interventions and farmer's practices were studied based on survey and group discussion with a farmer interactive group (FIG) of Onion growers. Each trail was conducted on an area of 0.40 ha and the same area adjacent to the trail plot was kept as farmer's practices. To find out the constraints in onion production, Participatory Rural Appraisal (PRA) technique was used. Preferential ranking technique was utilized to identify the constraints faced by the respondent farmers in onion production. Immbalance fertilizer application, No use of bio control agents and indiscriminate use of pesticide at insect and disease appearance are the major constraints of lower productivity and post harvest loss. Based on higher order problems identified, on farm trails were conducted at the farmers' field with the following treatments.

In the area where Thrips and stemphilium blight are major problem the IPM package were taken as growing of health nursery, seedling treatment with *Trichoderma viride* @ 10 gm/lit of water, installation of blue sticky trap @ 150 /ha, spray of Spinosad at 40-45 day after planting followed by spray of tebuconazole at 55-60 days compared with farmers practice (Spray of Trizophos + Mancozeb at thrips or disease appearance).

For the management of stored fungi, disease management module taken as seedling treatment with *Trichoderma viride*, application of nitrogen (100 kg/ha) in 2-3 split doses with in 60 DAT, Spray of 0.1% Carbendazim before 20 days of harvesting compared with farmers practice (cultivation of Onion variety Nasik red and injudicious use of Nitrogen fertilisers).

The trials were regularly monitored from sowing till harvesting on farmer's field by Plant Protection Scientist of KVK. The data on thrips population, incidence stemphilium disease as well as fungal infection during storage, yield were recorded from trial as well as farmers practice plot. The net monetary return and benefit cost (B: C) ratio were calculated based on current market price as suggested by [4].

Results and Discussion

During extensive survey conducted in farmer's field in the onion growing area in Sagar district of Madhya Pradesh, the thrips is found as a key pest. They are cosmopolitan in nature. Both immature and adult thrips feed by piercing surface tissues and suck the exuded plant juices. The average incidence of thrips was 42 and 8.4 per plant in farmer practice and IPM treatment. The results regarding control of population of thrips was in close agreement with the findings of [1] who also found the spray of systemic insecticide Imidacloprid 17.8 SL controlled the thrips effectively. The seedling treatment with *Trichoderma viride* @ 10 gm/lit of water and spray of tebuconazole at 55-60 days controlled stemphilium blight incidence significantly over farmers practice. These results are in accordance with the findings of [7, 2] who also found reduction in disease by the application of *Trichoderma harzianum* in the fields before infection and spray of Tebuconazole at 55-60 days, respectively.

The proper management of crop and control of thrips and stemphilium blight resulted 25.5 per cent increase in yield (145 q to 182 q/ha). The economic viability of IPM technologies over traditional farmer's practices was calculated depending on prevailing prices of inputs and output costs. Different variables like seed, fertilizers, pesticides and IPM materials were considered as cash input for technology demonstrations as well as farmers practice. It was found that average cost of production of Onion under IPM technologies was 62,000 per ha over farmers practice which was 55,000 per ha. The average of additional cost Rs. 7000 per ha increased the average net return of Rs. 29600 per ha in the IPM technologies was mainly due to more cost involved in IPM materials and balanced fertilizer application which will be reduced in subsequent years. The use of IPM technologies also gave higher benefit cost ratio 3.34 as compared to 3.0 under farmers practice in the corresponding years.

During the investigation it is found that green-dusty spore masses develop along the mid ribs and under the surface scales in the month of April and May. In storage, especially in humid conditions a sparse green, felt-like growth occurs in the neck, and on both surfaces of the outer scale. Black mould occurs in a similar way to blue-green mould and frequently it has been seen that the two fungi occur together. Sooty-black spore masses usually develop underneath the surface scales and tend to be much more prominent than blue-green mould. The most favourable temperature conditions for the growth of the fungus is 28°C-34°C followed by the warm and moist conditions as also reported [10]. By the adoption of proper management fungal infection reduced from 63 to 30 per cent (52.1%) and increased shelf life of the Onion in storage. The results are accordance with [11] who also found 40% storage losses due to fungal pathogen reduced by spraying of Carbendazim 50% WP as pre-harvest application. Due to increase in self life higher rates obtained by the farmers by the selling of onion in the month of August and September. The net return increased from Rs. 63,000 to 1, 01,000 per hectare and B: C ratio 3.62 to 4.54. Chemical treatment is found best to inhibit black mold and other fungal pathogens disease in the onion bulbs as also reported [12].

Table 1: Effect of IPM on Thrips population, Stemphilium blight disease incidence, yield of Onion and its economics (Mean of Three years)

Treatments	Thrips population (Per plant)	Disease incidence (%)	Yield (q/ha)	Cost of Cultivation (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Farmers Practice (Spray of Trizophos + Mancozeb at disease appearance)	42	24.2	145	55000	116000	3.00
Growing of health nursery of Onion, seedling treatment with	8.5	8.0	182	62000	145600	3.34

Trichoderma viride @ 10 gm/lit of water, installation of blue sticky trap @ 150 /ha, spray of Spinosad at 40-45 day after planting followed by spray of tebuconazole at 55-60 days.						

Table 2: Effect of Post-harvest Management practices to increase shelf life Onion and its economics (Mean of Three years)

Treatments	Yield (q/ha)	Fungal infection (%)	Cost of Cultivation (Rs./ha)	Net returns (Rs./ha)	B:C ratio
Onion variety Nasik red and injudicious use of Nitrogen (Farmers Practice)	195	63	52000	63000	3.62
Onion variety Nasik red, Seedling treatment of onion with *Trichoderma viride*, application of 100 kg/ha nitrogen in 2-3 split doses, Spray of 0.1% Carbendazim before 20 days of harvesting.	220	30	75000	101,000	4.54

Fig 1: Stemphilium Blight Disease in Onion

Fig 2: Thrips infestation in Onion

Fig 3: Management of Fungi in storage

Conclusions

Onion Cultivation depends on many biotic and abiotic factors, out of which incidence of thrips, stemphilium blight and stored fungi reduced yield as well as market value. For better yield and profit from onion, adoption of IPM *i.e*. growing of health nursery, seedling treatment with *Trichoderma viride* @ 10 gm/lit of water, installation of blue sticky trap @ 150 /ha, spray of Spinosad at 40-45 day after planting followed by a spray of tebuconazole at 55-60 days reduced the incidence of thrips and stemphilium blight disease as well as higher net returns per hectare in comparison to the farmers own practices The store fungi i.e. *Aspergillus* spp, *Penicillium* spp, *Alternaria* spp, *Fusarium* spp, *Rhizopus* sp., C*olletotrichum* spp., and *Botrytis* spp significantly controlled by the spray of 0.1% Carbendazim before 20 days of harvesting.

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