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Influence of intercrops on the incidence of thrips, *Thrips tabaci* (L.) in onion ecosystem

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Abstract
A field experiment comprising of different intercrops *viz.*, carrot, tomato, palak, radish, bhendi, coriander, chilli and french bean were screened in onion ecosystem at 3:1 proportion at Main Agricultural Research Station, Raichur during *kharif* season of 2016-17. Observations on population of thrips, *Spodoptera litura* larval population were registered at 15, 30, 45, 60, 75 and 90 days after transplanting. The results revealed that onion intercropped with carrot reduces the incidence of both thrips and *Spodoptera litura* larval population on main crop with 25.43 per plant and 0.90 per plant, respectively which showed non-significant difference with onion + tomato (28.62/plant and 0.99/plant, respectively) and onion + palak (29.95/plant and 1.04/plant, respectively). On the contrary, thrips and larval population was significantly high in onion monocropping (37.46 /plant and 1.59/plant, respectively). Further, onion intercropped with carrot ecosystem recorded the significantly highest bulb yield (8.90 t/ha) followed by onion + tomato (8.70 t/ha), onion + french bean (8.60 t/ha).

Keywords: Intercrop, Onion, *Spodoptera litura* and Thrips

Introduction
Onion is an important commercial crop of India with production of 21.71 million tonnes and productivity of 16.97 kg per hectare [2]. In Karnataka the area under onion is 0.19 million hectares with a production of 2.76 million tonnes and productivity of 14.16 kg per ha [2]. It is mainly used for cuisine and culinary purpose. It is an export oriented crop earning valuable foreign exchange for the country [17]. Onion has medicinal values and used for preparation of various Homeopathic, Unani and Ayurvedic medicines. Insect pests play an important role in reducing onion yield specially, thrips, *Thrips tabaci* Lindeman, armyworm, *Spodoptera litura* Fab, *Spodoptera exigua* Hubner, onion maggot, *Delia antique* Meigen, cutworm, *Agrotis segetum* Schiff are the major pests and aphids, *Myzus ascalornicus* Doncaster and bulb mites, *Rhizoglyphus sp*. are being miner [1]. Thrips, *T. tabaci* is a most serious and persistent pest found in cropping season in onion growing regions worldwide [5, 9] and causing average yield loss upto 60 per cent of bulb yield [16]. Several sustainable practices are being used worldwide reducing thrips infestation of vegetable crops. These practices are very helpful in reducing the injudicious use of broad spectrum insecticides [11, 14] which cause severe effects on the economy of a country. Intercropping and plant spacing are very important agronomic techniques that keep thrips population below economic injury level in onion crop [12]. Intercropping has wide range of benefits including suppression of weeds, improvement in soil fertility, conservation of natural predatory fauna and higher production [14, 13]. Reasonable plant spacing alters the behaviour of insects by reducing appropriate egg laying site and shelter leading to healthy plant growth and lower risks of pest outbreak and diseases [4, 6]. The intercropping and mixed cropping in various crops has been reported to reduce the pest incidence in different crops. Mixed cropping of carrots and onion reduced the thrips incidence [16] and intercropping of onion and garlic with tomato found to decrease the level of thrips incidence by 79 to 85% [1]. The present study was undertaken to assess the influence of various intercrops on the insect pests in onion ecosystem.

2. Material and Methods
The present study was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Raichur, Karnataka during 2016-'17 to evaluate the effectiveness of intercropping *viz.*, carrot, tomato, bhendi, chilli, palak, radish, french bean and coriander in

onion ecosystem. Intercrops *viz.*, tomato, chilli and onion which are intended for transplanting were sown in the nursery to raise the seedlings and later one month old seedlings were transplanted in the main field. Both seedlings and seeds of the intercrops were transplanted and or sown on same day (11th August, 2016) in a plot size of 3×3 ft with randomized complete block design layout replicated thrice. Further, crops were raised by following the recommended agronomic practices prescribed by the University of Agricultural Sciences, Raichur [3]. Different intercrops *viz.*, carrot, tomato, palak, radish, bhendi, coriander, chilli and french bean was raised with onion in 3:1 row proportion.

Observations were recorded on number of thrips and defoliator was counted on five randomly selected plants from each replication at 15, 30, 45, 60, 75 and 90 days after transplanting. Finally, yield per plot was also recorded which was later converted to per ha basis.

Statistical analysis

The data generated on population of thrips and defoliators were transformed to square root values before subjected for statistical analysis.

3. Result and Discussion

Infestation of thrips varied significantly across different intercrops in onion ecosystem. Population of thrips was less in intercropping situations than in sole cropping. The mean incidence of thrips was significantly less on onion intercropped with carrot (7.06/plant) which was on par with onion + tomato (7.33 thrips/plant), onion + palak (7.80 thrips/plant), onion + radish (8.53 thrips/plant) and onion + bhendi (8.60 thrips/plant). On the contrary, thrips population was significantly high in onion monocropping (9.86 thrips/plant) at 15 days after transplanting (Table 1). Subsequent observation registered on 30 days after transplanting found that the minimum thrips population was noticed once again in onion intercropped with carrot (20.80 thrips/plant) which showed non-significant difference with onion + tomato (22.80 thrips/plant) and onion + palak (25.80 thrips/plant) which were significantly different from remaining intercrops. However, sole onion harboured maximum population of 34.33 thrips/plant. Further, when observations were documented at 45, 60, 75 and 90 days after transplanting similar situation was noticed wherein, once again onion + carrot found to be best combination in reducing thrips incidence. The pooled data on thrips in different intercrops indicated that onion was intercropped with carrot was recorded less thrips population (25.43 /plant) which was followed by tomato (28.62 thrips/plant), palak (29.95 thrips/plant) and radish (30.45 thrips/plant). The present findings are in conformity with results of Gachu *et al.* [7] and Hossain *et al.* [8] who also reported that intercropping of onion with carrot known to reduce thrips population on onion by attracting them to carrots by way of physical interference resulting in reduction of thrips population. Similarly, Alston and Drost [2] reported that intercropping or mixed planting of carrots and onions reduced the thrips population on onions by attracting them to carrots, wherein thrips injury was tolerated by carrots without yield loss. Manjunath *et al.* [13] conducted an experiment at Arabhavi, Karnataka on intercropping of chilli with tomato, garlic, coriander and green gram and found lesser population of thrips. Intercropping of chilli with tomato proved better in reducing the thrips population about 1.88 and 2.25/leaf, followed by intercropping with chilli + garlic (2.93 and 2.41/leaf) and chilli + coriander (3.19 and 3.70/leaf), but best chilli yields were obtained with chilli + tomato and chilli + greengram (7.99 q/ha) intercropping systems. Aswathanarayanareddy *et al.* [6] conducted field experiment, intercropping of chilli with onion, garlic, brinjal, bhendi, marigold, maize and beans. The results revealed that chilli intercropped with garlic/onion consistently recorded lowest pest infestation compared to chilli sole crop. While, the studies made by Thiunissen [17] reported that plant volatiles released by non-host plants intercropped in field vegetables decreased infestation of pests in base crops. Mixed cropping of carrots and onion reduced the thrips incidence [15] and intercropping of onion and garlic with tomato found to decrease the level of thrips incidence by 79 to 85% [1].

Similarly, onion intercropped with carrot could able to reduce larval population of *Spodoptera litura* (0.20/plant), which was followed by tomato (0.33/plant), palak (0.40/plant), radish (0.40/plant), bhendi (0.60/plant) and chilli (0.80/plant). Whereas, onion alone recorded highest population of *Spodoptera litura* larvae (0.80/plant) at 15 days after transplanting. Further, when observations was documented at 30 days after transplanting showed minimum larval population in onion intercropped with carrot (0.86/plant) followed by onion + tomato (0.93/plant) which proved its superiority over all other intercrops. On the contrary the larval population was significantly higher in onion sole cropping (1.66/plant). Subsequent observation registered on 45, 60, 75 and 90 days after transplanting depicted similar trend. This clearly showed that intercropping of onion is better than sole crop in respect of reducing the food for pests. This was because of onion odor emits sulphur containing organic compounds called thiols and these substances can help in various protective mechanism. The present findings are in accordance with Mann *et al.* [14] who reported that intercropping of lettuce with onion reduces the population of caterpillar *A. ipsolon* in lettuce. Among the different intercropping systems, onion + carrot recorded significantly higher good bulb yield (8.90 t/ha) followed by onion + tomato (8.70 t/ha) and onion + french bean (8.60 t/ha) than in the other intercropping system.

Table 1: Influence of intercrops on the incidence of thrips in onion ecosystem

Treatment details	Mean number of thrips/plant at different intervals						Mean
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	
Onion + Carrot @ 3:1 ratio	7.06 (2.75)^{a}	20.80 (4.61)^{a}	26.80 (5.22)^{a}	32.46 (5.74)^{a}	32.8 (5.77)^{a}	32.66 (5.75)^{a}	25.43 (5.09)^{a}
Onion + Chilli @ 3:1 ratio	8.86 (3.06)^{bcd}	30.20 (5.54)^{bcd}	36.00 (6.04)^{bcd}	45.80 (6.80)^{bc}	45.6 (6.78)^{cd}	39.66 (6.33)^{d}	34.35 (5.90)^{bc}
Onion + Radish @ 3:1 ratio	8.53 (3.00)^{abcd}	27.60 (5.30)^{abcd}	33.60 (5.83)^{abcd}	39.66 (6.33)^{ab}	38.00 (6.20)^{abc}	35.33 (5.98)^{abc}	30.45 (5.56)^{abc}
Onion + French bean @ 3:1 ratio	9.26 (3.12)^{cd}	32.66 (5.75)^{cd}	37.00 (6.12)^{cd}	47.06 (6.89)^{bc}	47.26 (6.91)^{d}	38.00 (6.20)^{bcd}	35.20 (5.97)^{c}
Onion + Palak @ 3:1 ratio	7.80	25.80	31.40	40.00	39.40	35.35	29.95

	$(2.88)^{abc}$	$(5.12)^{abc}$	$(5.64)^{abc}$	$(6.36)^{ab}$	$(6.31)^{abc}$	$(5.95)^{ab}$	$(5.51)^{abc}$
Onion + Bhendi @ 3:1 ratio	8.60 $(3.01)^{abcd}$	30.26 $(5.54)^{bcd}$	36.80 $(6.10)^{cd}$	44.73 $(6.72)^{bc}$	45.66 $(6.79)^{cd}$	39.00 $(6.28)^{cd}$	34.17 $(5.88)^{bc}$
Onion + Tomato @ 3:1 ratio	7.33 $(2.79)^{ab}$	22.80 $(4.82)^{ab}$	28.80 $(5.41)^{ab}$	40.00 $(6.36)^{ab}$	37.80 $(6.18)^{ab}$	35.00 $(5.95)^{ab}$	28.62 $(5.39)^{ab}$
Onion + Coriander @ 3:1 ratio	9.33 $(3.13)^{cd}$	30.80 $(5.59)^{bcd}$	38.80 $(6.26)^{cd}$	45.80 $(6.80)^{bc}$	44.8 $(6.73)^{bcd}$	36.80 $(6.36)^{d}$	34.38 $(5.90)^{bc}$
Onion alone	9.86 $(3.21)^{d}$	34.33 $(5.90)^{d}$	40.46 $(6.39)^{d}$	50.7 $(7.13)^{c}$	49.06 $(7.26)^{d}$	40.40 $(6.39)^{d}$	37.46 $(6.16)^{cd}$
S.Em (±)	0.10	0.26	0.23	0.22	0.20	0.10	0.18
CD @ 5%	0.29	0.77	0.68	0.65	0.59	0.30	0.54
CV (%)	5.61	8.37	6.73	5.96	5.02	5.67	6.22

DAT- Days after transplanting

Figure in parentheses are $\sqrt{x+0.5}$ transformed values.

Table 2: Influence of different intercrops on the incidence of *S. litura* in onion ecosystem

Treatment details	Mean number of *S. litura* larvae/plant							Yield
	15 DAT	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	Mean	Onion bulb (t/ha)
Onion + Carrot @ 3:1 ratio	0.20 $(0.83)^{a}$	0.86 $(1.16)^{a}$	0.93 $(1.19)^{a}$	1.26 $(1.32)^{a}$	1.06 $(1.25)^{a}$	1.13 $(1.27)^{a}$	0.90 $(1.17)^{a}$	8.90
Onion + Chilli @ 3:1 ratio	0.80 $(1.14)^{b}$	1.13 $(1.27)^{ab}$	1.53 $(1.42)^{cd}$	1.65 $(1.46)^{bc}$	1.68 $(1.47)^{bc}$	1.58 $(1.44)^{bc}$	1.39 $(1.33)^{abc}$	8.00
Onion + Radish @ 3:1 ratio	0.40 $(0.94)^{ab}$	1.13 $(1.27)^{ab}$	1.30 $(1.34)^{bcd}$	1.33 $(1.34)^{ab}$	1.40 $(1.39)^{abc}$	1.33 $(1.34)^{abc}$	1.14 $(1.28)^{abc}$	8.20
Onion + French bean @ 3:1 ratio	0.80 $(1.14)^{b}$	1.53 $(1.42)^{bc}$	1.33 $(1.35)^{bcd}$	1.64 $(1.46)^{bc}$	1.86 $(1.51)^{c}$	1.63 $(1.46)^{bc}$	1.46 $(1.36)^{bc}$	8.60
Onion + Palak @ 3:1 ratio	0.40 $(0.94)^{ab}$	1.06 $(1.25)^{a}$	1.13 $(1.27)^{ab}$	1.33 $(1.34)^{ab}$	1.13 $(1.27)^{ab}$	1.26 $(1.32)^{ab}$	1.04 $(1.25)^{ab}$	8.20
Onion + Bhendi @ 3:1 ratio	0.60 $(1.03)^{ab}$	1.26 $(1.32)^{abc}$	1.33 $(1.35)^{bcd}$	1.62 $(1.45)^{bc}$	1.65 $(1.46)^{bc}$	1.72 $(1.48)^{c}$	1.36 $(1.32)^{abc}$	8.00
Onion + Tomato @ 3:1 ratio	0.33 $(0.91)^{a}$	0.93 $(1.19)^{a}$	1.26 $(1.32)^{abc}$	1.33 $(1.34)^{ab}$	1.13 $(1.27)^{ab}$	1.26 $(1.32)^{ab}$	0.99 $(1.22)^{ab}$	8.70
Onion + Coriander @ 3:1 ratio	0.80 $(1.12)^{b}$	1.53 $(1.42)^{bc}$	1.33 $(1.35)^{bcd}$	1.70 $(1.48)^{c}$	1.63 $(1.46)^{bc}$	1.59 $(1.45)^{bc}$	1.43 $(1.34)^{bc}$	7.93
Onion alone	0.80 $(1.14)^{b}$	1.66 $(1.47)^{d}$	1.70 $(1.48)^{d}$	1.76 $(1.50)^{c}$	2.00 $(1.58)^{c}$	1.63 $(1.46)^{bc}$	1.59 $(1.43)^{c}$	8.00
S.Em (±)	0.07	0.05	0.05	0.04	0.07	0.05	0.05	0.45
CD @ 5%	0.20	0.16	0.14	0.12	0.20	0.15	0.16	1.34
CV (%)	11.50	7.18	6.16	5.58	8.29	6.53	7.54	10.15

DAT- Days after transplanting

Figure in parentheses are $\sqrt{x+0.5}$ transformed value.

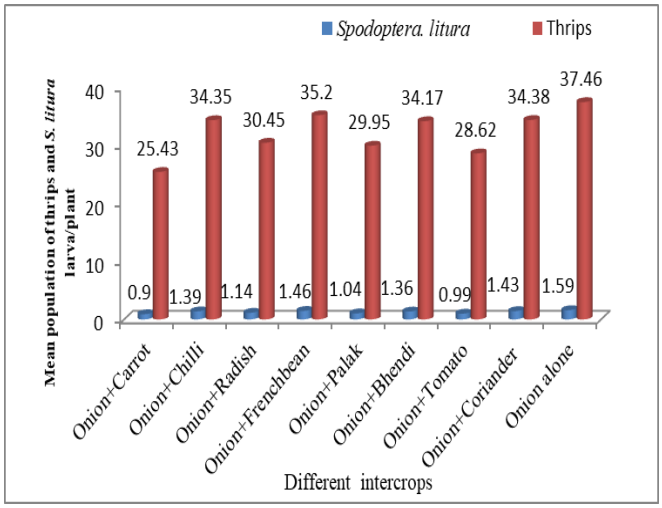

Fig 1: Influence of different intercrops on thrips and *S. litura* in onion ecosystem

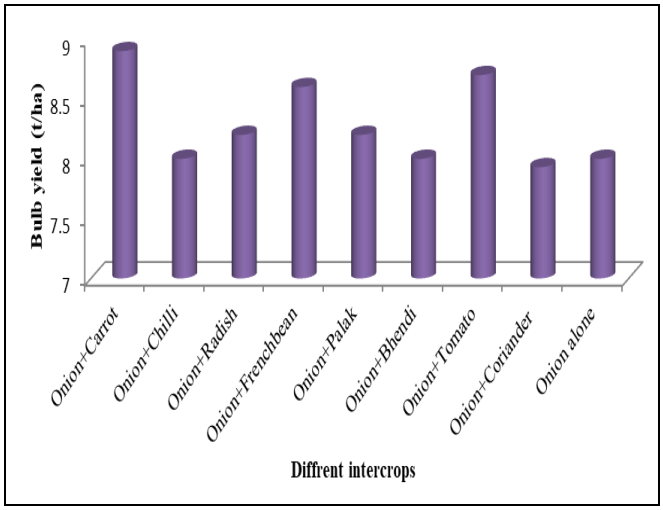

Fig 2: Influence of intercrops on onion yield

5. Conclusion

Intercropping fits into environmentally acceptable and sustainable vegetable-producing practices. From the study, it may be concluded that carrot or tomato intercrop may be utilized for the management of thrips infesting onion with higher economic return.

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