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RESEARCH ARTICLE

SCREENING OF SWEET POTATO (*IPOMOEA BATATAS*) CULTIVARS FOR THE INCIDENCE OF SWEET POTATO WEEVIL (*CYLAS FORMICARIUS* F). UNDER THE IRRIGATED CONDITION

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ABSTRACT

Sweet potato weevil is considered as one of the most significant pest of sweet potato (*Ipomoea batatas*) in Karaikal region. Field trial was conducted in a season with two different cultivars. Two different cultivars of sweet potato were studied during the year 2010-2011 recent years have appeared Moderately susceptible to Sweet potato weevil in the field condition. Pest assessments based on the proportion of infested to healthy vine cuttings about the plant crown were conducted. Significant differences in the levels of infested vine were found between two cultivars evaluated. Villupuram local (Red) had a low level of infested tubers recorded in term of percentage tuber yield kgha-1 (54.64%) while Karur local (White) recorded as high level of infested tuber (60.41%) but both cultivars showed Moderately susceptible levels.

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INTRODUCTION

Sweet potato is a poor man's crop with high productivity per unit area and time. The productivity of sweet potato in India is 8.2 t/ha which is just half that of Asia (FAO, 1995). Among the constraints attributed to the production of sweet potato in India, the one caused by the weevil, *Cylas formicarius* Fabricius (Coleoptera: Curculionidae) is the most important one. The weevil was first described in 1798 from a specimen collected at tranquebar near Madras, India is found throughout tropics and sub tropics wherever the crop is cultivated (FAO, 1995). Though the pest damages the tuber both in field and in storage, the major damage occurs in the field (Pillai and Palaniswami, 1984). Even the slightly infested the tuber unfit for consumption both human and cattle (Season and Crop Report, 2005-2006). The infested tuber is often riddled with cavities, spongy in appearance and dark in colour. In addition to damage caused directly by tunnelling, larvae cause damage indirectly by facilitating entry of soil-borne pathogens (Onwueme, 1978). Even low levels of feeding induce a chemical reaction that imparts a bitter taste and terpene odour to the tubers (Pillai *et al*., 1973). Larvae also mine the vine of the plant, causing it to darken, crack or collapse. The adult may feed on the tubers, creating numerous small holes that measure about the length of its head. The adult generally has limited access to the tubers, however, so damage by this stage is less severe than by larvae. Adult feeding on the foliage seldom is of consequence. It is inherently of interest to entomologists due to its strikingly colourful appearance and extremely long rostrum (beak). Sweet potato weevil is often considered to be the most serious pest of sweet potato, with reports of losses ranging from five to 97% in areas where the weevil occurs.

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MATERIALS AND METHODS

Field experiment was conducted during summer 2011 (June-November) in Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal. The experiment was laid out in Factorial Randomised Block Design (FRBD) (Varieties was one factor and treatments was another factor so, two factor considered as factorial design) with two cultivars and ten treatments. The plot size was 4.0 x 3.0 m ($12m^2$) accommodating 120 plants. The crop was raised in beds and channels and the spacing 60 x 20 cm was adopted between rows and between plants respectively. Two cultivars of sweet potato (*Ipomoea batatas*) *i.e*., Villupuram local (Red) (Plate 1) and Karur local (White) (Plate 2) were used for this study. Terminal stem cuttings of sweet potato were planted in field. The experiment was carried out in sandy loam soil with a fine texture ideally suited for growing tuber crops. Farm yard manure @ 12.5 tonnes ha^{-1} was applied uniformly before the

last ploughing. Fertilizers such as urea, super phosphate and potash were applied to supply 20N: 40P: 60K ha^{-1} on the day of planting (Crop production techniques of horticultural crops, 2004). The treatments were replicated thrice. Stem cuttings were dipped in imidacloprid @ 22.25 g a.i. ha^{-1} and nimbecidine 0.50 per cent solution as treatments T_1 and T_2 respectively. Stem cuttings measuring about 10-15 cm were made in to a bundles and they were dipped for a minute in the above said insecticidal solution and used in treatments T_1 and T_2. These treated cuttings were kept in shade and they were partially covered with wet jute gunny for three days and then planted (Rhodes, 1959; Ingram, 1967).

Plate 1. Villupuram local (Red) vine

Plate 2. Karur local (White) vine

Plate 3. Mulching with paddy straw at 60 DAP

Three insecticides *viz.,* imidacloprid @ 22.25 g a.i. ha^{-1} (T_3 - Foliar sprayimidachloprid @ 22.25 g a.i. ha^{-1}), acephate @ 468.75 g a.i. ha^{-1} (T_4-Acephate foliar spray @ 468.75 g.i. ha^{-1}) and neem oil 3 per cent were used for three times as foliar sprays at 30th, 60th and 75th DAP using high volume sprayer (Hand operated Knapsack sprayer) @ 500 liters of spray fluid ha^{-1}. In neem oil spray khadi soap was added @ 5 grams for ten liters of water to get uniform emulsion. Phorate @ 1000 g a.i. ha^{-1} was mixed with sand and applied in a ring around base of each plant twice at 30th and 60th days after planting (DAP). Three eco-friendly treatments such as mulching with paddy straw (Plate 3) and earthing up at 30th and 60th DAP, application of neemcake @ 375 kg ha^{-1} with three levels of potash (K) applied in three equal split doses at 40th, 60th and 75th days after planting (DAP). The levels of potash were 45, 60 and 90 kg ha^{-1}. Fifteen kg of potash ha^{-1} was applied as basal application in all the treatments. The rest of potasic fertilizer were applied in three equal splits at 40th, 60th and 75th days after planting (DAP). The cultivars were evaluated based on the weevil damage grade point scale number of tubers per plot, tuber yield kg per plot and tuber yield kg ha^{-1} (Netam *et al*., 2008) (Table.1). The statistical analysis was done using the AGRESS package.

RESULTS AND DISCUSSION

Evaluation of cultivars

The Karur local (White) and Villupuram local (Red) were evaluated as moderately susceptible based on infestation per cent it can be observed in Table 2. Between the cultivars the Karur local (White) was shown to have less infestation per cent on total number of tubers per plot, whereas infestation per cent on tuber yield kg per plot and tuber yield kg ha^{-1} shown to have the marginal higher values than Villupuram local (Red).

Table 1. Weevil damage grade point scale (Netam *et al*., 2008)

Grade	Per cent incidence	Reaction
0	0	Highly resistance
1	1-20	Resistance
2	20-40	Moderately resistance
3	40-60	Moderately susceptible
4	60-80	Susceptible
5	Above 80	Highly susceptible

Table 2. Evaluation of cultivars

	Infestation (%)#		
Tuber yield	Villupuram local (Red)	Karur local (White)	Damage grade
Number of tubers/plot	60.24^{b}	55.26^{a}	
Tuber yield kg/plot	54.69^{a}	60.33^{b}	MS
Tuber yield kgha^{-1}	54.64^{a}	60.41^{b}	

Mean of three replications; MS- Moderately Susceptible. a- indicate lowest infestation, b- indicate highest infestation

Impact of different treatments on the tuber infestation (weight basis in kg/hectare)

The yield data on the basis of kg per hectare was worked out with respect to total tubers, infested tubers, marketable tubers and per cent tuber infestation in different treatments imposed over Villupuram local (Red) and Karur local (White) cultivars against *C. formicarius* weevil are furnished in Table 3; Fig. 1. The yield of total tuber in treatments kg ha^{-1} in respect of different treatments was ranged from 6243 to 8396.

Table 3. Impact of different treatments on the tuber infestation (weight basis kg/hectare)

Treat Nos.	Total tuber yield# (kg/ha)			Weevil infested tuber yield# (kg/ha)			Marketable tuber yield# (kg/ha)			Infestation (%)#		
	Red	White	Mean	Red	White	Mean	Red	White	Mean	Red	White	Mean
T_1	7667^{bcd}	8111^{bc}	7889^{ab}	4917	5111	5014^{b}	2750^{c}	3000^{c}	2875^{d}	64.18^{e}	63.07^{e}	63.62^{d}
T_2	7681^{bcd}	8583^{ab}	8132^{ab}	4820	4917	4868^{b}	2861^{c}	3611^{c}	3236^{cd}	63.13^{e}	58.19^{cde}	60.66^{d}
T_3	8208^{bc}	6387^{de}	7299^{bc}	2887	3417	3153^{c}	5319^{ab}	3000^{c}	4160^{ab}	35.17^{a}	53.64^{bcd}	44.40^{b}
T_4	8500^{abc}	5306^{e}	6903^{cd}	2250	2389	2320^{d}	6260^{a}	2917^{c}	4583^{a}	26.41^{a}	45.68^{b}	36.05^{a}
T_5	7375^{bcd}	5111^{e}	6243^{d}	2430	2528	2479^{d}	4945^{b}	2583^{c}	3764^{bc}	33.37^{a}	50.01^{bc}	41.69^{ab}
T_6	9597^{a}	7195^{cd}	8396^{a}	4653	4583	4618^{b}	4945^{b}	2611^{c}	3978^{abc}	48.39^{b}	63.65^{e}	56.01^{c}
T_7	8028^{bc}	8306^{abc}	8167^{ab}	5056	5083	5069^{b}	2972^{c}	3222^{c}	3097^{cd}	63.85^{e}	61.45^{de}	62.64^{d}
T_8	7833^{bc}	7750^{bcd}	7792^{abc}	4778	4806	4792^{b}	3056^{c}	2944^{c}	3000^{cd}	61.53^{e}	62.51^{de}	62.02^{cd}
T_9	7194^{cd}	7798^{bc}	7486^{abc}	4722	4722	4722^{b}	2472^{c}	3056^{c}	2764^{d}	65.83^{e}	61.47^{de}	63.65^{d}
T_{10}	8195^{bc}	7806^{bc}	8000^{ab}	6945	6583	6764^{a}	1250^{d}	1222^{d}	1236^{e}	84.58^{f}	84.40^{f}	84.45^{e}
Mean	8028^{A}	7233^{B}		4346	4414		3682^{A}	2817^{B}		54.64^{A}	60.41^{B}	
	SED	CD		SED	CD		SED	CD		SED	CD	
V	214	433		112	NS		178	361		1.41	2.85	
T	478	967		251	509		398	806		3.15	6.38	
VxT	676	1368		355	NS		563	1141		4.46	9.02	

Mean of three replications; Values with same alphabet are statistically equal at P=0.05. SED – standard error difference, CD – critical difference, NS- non significant, V- varieties, T- treatment, V*T- varieties and treatments interaction.

Treatments

T_1- Stem cuttings dipping in imidachloprid @ 22.25 g a.i. ha^{-1}	T_6- Phorate @ 1000 g a.i. ha^{-1}
T_2- Stem cuttings dipping in nimbecidine 0.50 per cent solution	T_7- Neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 45 kg ha^{-1}
T_3- Foliar spray imidachloprid @ 22.25 g a.i. ha^{-1}	T_8- Neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 60 kg ha^{-1}
T_4- Acephate foliar spray @ 468.75 g.i. ha^{-1}	T_9- Neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 90 kg ha^{-1}
T_5- Neem oil 3 per cent foliar spray	T_{10}- Control.

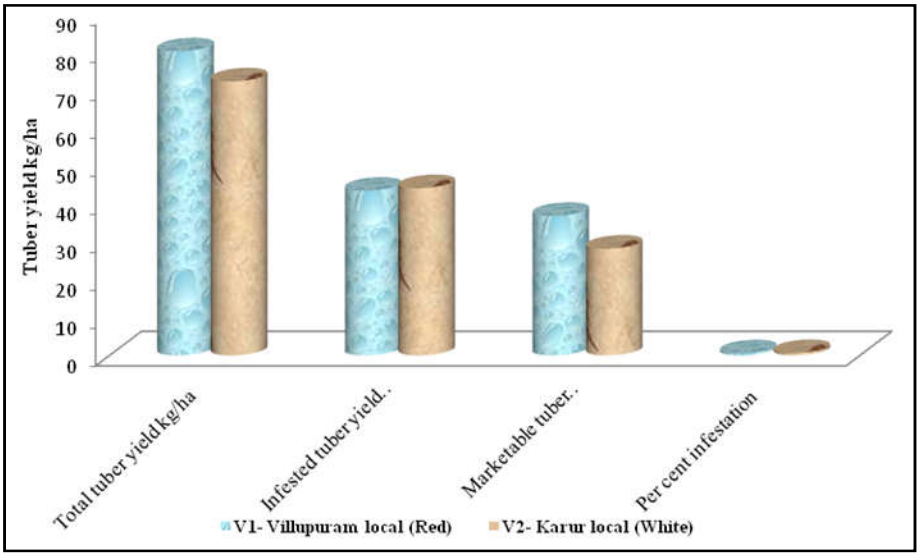

Fig. 1. Impact of different cultivars on the tuber infestation (weight basis /ha)

The highest tuber yield was recorded in phorate @ 1000 g a.i. ha^{-1} (8396 kg) followed by neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 45 kg ha^{-1} (8167 kg), stem cuttings dipping in nimbecidine 0.50 per cent solution (8132 kg). The lowest tuber yield was recorded in neem oil 3 per cent foliar application (6243 kg) followed by acephate @ 468.75 g a.i. ha^{-1} as foliar application (6903 kg) and imidachloprid @ 22.25 g a.i. ha^{-1} foliar application (7299 kg). While comparing the cultivars, the Villupuram local (Red) cultivar was performed better (8028 kg) than Karur lcoal (White) cultivar (7233 kg). The interaction effect between the cultivars and treatments indicated that in Villupuram local (Red) cultivar the mean tuber yield was ranged from 7194 to 9597 kg. The lowest tuber yield was registered in neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 90 kg ha^{-1} (7194 kg) and highest tuber yield was recorded in phorate @ 1000 g a.i. ha^{-1} (9597 kg) in respect of Villupuram local (Red) cultivar, whereas in Karur local (White) cultivar the lowest tuber yield was recorded in neem oil 3 per cent foliar sprayed plot (5111 kg) and highest tuber yield was recorded in stem cuttings dipping in nimbecidine 0.50 per cent solution (8583 kg). Infested mean tuber in treatments was ranged from 2320 to 6764 kg ha^{-1}. The highest infested tuber was recorded in control (6764 kg) followed by neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 45 kg ha^{-1} (5069 kg), stem cuttings dipping in imidachloprid @ 22.25 g a.i. ha^{-1} (5014 kg). The lowest infested tuber was recorded in acephate @ 468.75 g a.i. ha^{-1} as foliar application (2320 kg) preceded by neem oil 3 per cent

foliar application (2479 kg) and imidachloprid @ 22.25 g a.i. ha^{-1} foliar application (3153 kg). Marketable tuber mean yield was ranged from 1236 to 4583 kg ha^{-1}. The highest marketable tuber was recorded in acephate @ 468.75 g a.i. ha^{-1} as foliar application (4583 kg) followed by imidachloprid @ 22.25 g a.i. ha^{-1} foliar application (4160 kg) and phorate @ 1000 g a.i. ha^{-1} (3978 kg). The lowest marketable tuber was recorded in control (1236 kg) preceded by neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 90 kg ha^{-1} (2764 kg) and stem cuttings dipping in imidachloprid @ 22.25 g a.i. ha^{-1} (2875 kg). Among two cultivars, the Villupuram local (Red) cultivar was recorded as better performed cultivar (3682 kg) followed by Karur local (White) cultivar (2817 kg).

The interaction effect between cultivars and treatments indicated that in Villupuram local (Red) cultivar the marketable mean yield of tuber was ranged from 1250 to 6260 kg ha^{-1}. The highest marketable tuber yield kg ha^{-1} was recorded in acephate @ 468.75 g a.i. ha^{-1} as foliar application (6260 kg), followed by imidachloprid @ 22.25 g a.i. ha^{-1} foliar application (5319 kg). The lowest marketable tuber yield recorded in control was 1250 kg ha^{-1} preceded by neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 90 kg ha^{-1} (2472 kg). In Karur local (White) cultivar, the mean of marketable tuber yield was ranged from 1222 to 3611 kg ha^{-1}. The highest marketable tuber yield was recorded in stem cuttings dipping in nimbecidine 0.50 per cent solution (3611 kg) followed by neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 days after planting (DAP) plus potash 45 kg ha^{-1} (3222 kg), and neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 90 kg ha^{-1} (3056 kg). The lowest marketable tuber yield was recorded in control (1222 kg) preceded by neem oil 3 per cent foliar application (2583 kg) and phorate @ 1000 g a.i. ha^{-1} (2611 kg). The mean of per cent infestation was ranged from 36.05 to 84.45. The lowest per cent of infestation was recorded in acephate @ 468.75 g a.i. ha^{-1} as foliar application (36.05%) preceded by neem oil 3 per cent foliar application (41.69%) and imidachloprid @ 22.25 g a.i. ha^{-1} foliar application (44.40%). Highest per cent infestation was recorded in control (84.45%) followed by neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 90 kg ha^{-1} (63.65%). All the treatments were found to be significantly superior over control. On comparing both cultivars, the Villupuram local (Red) cultivar was performed better (54.64%) than Karur local (White) cultivar (60.41%) by the way of per cent infestation.

In respect of interaction effect between cultivars and treatments, the per cent infestation in Villupuram local (Red) cultivar was ranged from 26.41 to 84.58. The lowest per cent infestation was recorded in acephate @ 468.75 g a.i. ha^{-1} as foliar application (26.41%) preceded by neem oil 3 per cent foliar application (33.37%) and imidachloprid @ 22.25 g a.i. ha^{-1} foliar application (35.17%). The highest infestation per cent was recorded in control (84.58%) followed by neemcake 375 kg ha^{-1} plus mulching with paddy straw and earthing up at 30 and 60 DAP plus potash 90 kg ha^{-1} (65.83%) and stem cuttings dipping in imidachloprid @ 22.25 g a.i. ha^{-1} (64.18%). In Karur local (White) cultivar, the infestation was ranged from 45.68 to 84.40 per cent. The lowest infestation per cent was recorded in acephate @ 468.75 g a.i. ha^{-1} as foliar application (45.68%) preceded by neem oil 3 per cent foliar application (50.01%) and imidachloprid @ 22.25 g a.i. ha^{-1} foliar application (53.64%) per cent. The highest infestation per cent was recorded in control (84.40%) followed by phorate @ 1000 g a.i. ha^{-1} (63.65%) and stem cuttings dipping in imidachloprid @ 22.25 g a.i. ha^{-1} (63.07%). The white variety was recorded with lowest insect population. The result in agreement with the reports of Trehan and Bagal (1957) who reported that the less infestation in the white variety probably due to the fibrous nature of the tuber and this could be the reason for the less infestation in this experiments. According to Trehan and Bagal (1957) the white variety was relatively had less infestation than the red. Further the reports of Pillai *et al.,* (1981) indicated that the sweet potato tubers were protected by the foliar spray. Therefore the combined effective are varietal resistance and foliar spray could be the reason for reduced the weevil population. With respect to treatments alone acephate @ 468.75 g a.i. ha^{-1} was recorded with lowest infestation. Mule *et al.,* (2009) reported that the healthy cutting dipped in 0.1 per cent carbaryl before planting, mulching of paddy straw from 10 days after planting, earthingup of soil at 30 and 60 DAP combined with sex pheromone trap was most effective and produced highest tuber yield.

Conclusion

It has been concluded that the white cultivar (Karur local) was more resistance to the sweet potato weevil compared to the red cultivar (Villupuram local). Because white cultivar having more fibrous nature and latex content compared to the red cultivar.

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