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RESEARCH ARTICLE :

Evaluation of botanicals and insecticides against *Sitotroga cerealella* (Olivier) on stored paddy seeds

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SUMMARY : Rice, *Oryza sativa* L. is the most economically important food crop grown by millions of people in India. It plays a major nutritional role in the diet of people of many developing nations (Norman and Kebe, 2006; FAO, 2013).The productivity of rice is threatened by a wide range of pre and post harvest pests (Ashamo and Akinnawonu, 2012). Stored product insect pests such as *Sitophilus oryzae* (Linnaeus), *Sitophilus zeamais* (Motschulsky), *Rhyzoperthadominica* (Fabricius) and *Sitotroga cerealella* (Olivier) are usually seen on rice in most of the stores. An experiment was conducted at Seed Research and Technology Centre, Rajendranagar, Professor Jayashankar Telangana State Agricultural University, Hyderabad during 2015-16 to study the efficacy of botanicals on storability of paddy seeds through seed treatments. The storage studies revealed that among botanical seed treatments, significantly highest seed germination was recorded inseeds treated with *Acorus calamus* @ 10ml per kg seed (96.33%) followed by Karanj oil @ 5ml per kg seed (90.33%) and the lowest in untreated seeds (80.67%). Significantly highest seedling vigour was also observed in *Acorus calamus* @ 10ml per kg seed (1947) followed by Karanj oil @ 5ml per kg seed (1853) while significantly lowest seedling vigour index was recorded in untreated control (1458). Though lowest seed infestation was recorded in Karanj oil @ 5 ml/kg seed (5.3 %) but it was on par with *Acorus calamus* (8.0 %) at the end of twelve months of storage. Among the various treatments, *Acorus calamus* and Karanj oil were found to be superior in maintaining seed quality through out the storage period over control. In all the treatments, seed quality parameters declined progressively with increase in storage period. The average germination per cent age and vigour index of the seed at the beginning of storage period was 99.10 per cent and 3556, respectively, which declined to 90.71 per cent and 1766.71, respectively at the end of 12th month of storage.

KEY WORDS :
Paddy seeds, Angoumo is grain moth [*Sitotroga cerealella* (Olivier)], Management, Botanicals

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BACKGROUND AND OBJECTIVES

Rice, *Oryza sativa* L. is the most economically important food crop grown by millions of people in India. It plays a major nutritional role in the diet of people of many developing nations (Norman and Kebe, 2006; FAO, 2013).The productivity of rice is threatened by a wide range of pre and post harvest pests (Ashamo and Akinnawonu,

2012). Stored product insect pests such as *Sitophilus oryzae* (Linnaeus), *Sitophilus zeamais* (Motschulsky), *Rhyzoperthadominica* (Fabricius) and *Sitotroga cerealella* (Olivier) are usually seen on rice in most of the stores. Of all these pests, *S. cereallela* remained as one of the most destructive pests of rice (Togola *et al*., 2013). In fact, a starting population offemale *S. cerealella* has been estimated to completely destroy 500g of hulled rice with in three generations if left unchecked (Cogburn, 1975 and Togola *et al*., 2010). Similarly, adults of this insect are active fliers capable of travelling to a distance of 600 meters and infest other grains (e.g. maize, sorghum, wheat, barley and millet) apart from rice through cross infestation (Trematerra, 2015). Thus, adults of this insect not only infests a particular grain in storage, but other grains on the field which has further enhanced their ability to damage crops when compared to larval stage.

The use of synthetic insecticides has been adjudged to be the most effective method in the management of stored product pests especially under large scale production (Gbaye and Holloway, 2011). As, usage of synthetic insecticides results in various adverseen vironmental, biological and health consequences, efforts are being shifted towards other methods of control which are effective and eco-friendly. One of such methods involves the use of insecticides derived from plant origin. India is believed to be richly endowed with several botanicals which possess insecticidal and medicinal properties. Plant materials could therefore be used as an important weapon in achieving good protection of their farm produce.

RESOURCES AND METHODS

The experiment was carried out under ambient conditions at the Seed Research and Technology Centre, Rajendranagar, PJTSAU, Hyderabad during 2015-16. The paddy seeds (MTU1010 variety) were treated with Emamectin benzoate 5 SG@2ppm *i.e*., 40.0 mg/kg seed (T_1), Deltamethrin 2. 8 EC @ 1.0 ppm (0.04 ml/kg seed) (T_2), Neemazal 10000 ppm @ 1.5ml/ kg seed (T_3),Karanj oil @ 5 ml/kg seed(T_4), Citronella oil @ 5ml/kg seed(T_5), *Acorus calamus* @ 10 ml/kg seed(T_6) and Control (untreated seeds-T_7). The experiment was laid out in Completely Randomized Design with three replications. Before imposing treatments, seed moisture content was brought to 12 per cent by sun drying. Two kg of seeds of each treatment was treated with plant products and chemicals as per the specified treatments. The treated seeds were packed in cloth bag and stored along with untreated control under ambient storage for a period of 12 months. Data was recorded on the following parameters.

Percentage seed damage :

Percentage seed damage was calculated by taking a random sample of 100 seeds and counting the number of seeds with bored holes of *Sitotroga cerealella* and then converted into percentage.

$$\text{Percentage seed damage} = \frac{\text{Number of damaged seeds}}{\text{Total Number of seeds}} \times 100$$

Per cent seed germination:

Germination of the seeds was tested by paper towel method by maintaining three replications for each treatment. 100 paddy seeds were kept in moist paper towel and allowed to germinate in walk in germinator for 14 days and the percentage of germination was calculated by using the formula:

$$\text{Percentage of seed germination} = \frac{\text{Number of germinated seeds}}{\text{Total number of seeds}} \times 100$$

Seedling vigour index:

For determination the seedling vigour index of the paddy seeds, fourteen days old 10 healthy germinated seedlings were selected from each replication of the treatment and then shoot and root length of each of the 10 seedlings were measured in centimeters and average length of the seedlings was calculated

Seedling length =shoot length +root length

Seedling vigour index was calculated by multiplying germination percentage with seedling length as suggested by Abdul Baki and Anderson (1973)

Seedling vigour index (SVI)=Per cent seed germination X Seedling length

Seed moisture content :

Moisture content of the seed was recorded by using Dicky john moisture meter

Statistical analysis:

The data was analyzed by adopting Completely Randomized Design (CRD) as suggested by Panse and Sukhatme (1985).

OBSERVATIONS AND ANALYSIS

The data on seed quality parameters except moisture percentage varied significantly at 12 months of storage during the storage period in various treatments. The reduction in the germination of the seeds due to ageing and insect infestation upto 12 months of storage is presented in Table 1. At the end of the storage period, among the botanicals, significantly highest seed germination was recorded in seeds treated with *Acorus calamus* @ 10ml per kg seed (96.33%) followed by Karanj oil@5ml per kg seed (90.33%) and the lowest in untreated seeds (80.67%). Significantly highest seedling vigour was also observed in *Acorus calamus* @10ml per kg seed (1947) followed by Karanj oil @ 5ml per kg seed (1853) while significantly lowest seedling vigour index was recorded in untreated control (1458) (Table 1).

After 12 months of storage, significantly lowest seed infestation was observed in seeds treated with deltamethrin 2.8EC@0.04 ml per kg seed (3.0%) while among the botanicals, lowest seed infestation was observed in the seeds treated with Karanj oil@5ml per kg seed (5.30%), however it was on par with *Acorus calamus* treated seeds (8.0%). Significantly highest seed infestation was recorded in untreated seeds (18.2%) (Table 2).

In all the treatments, seed quality parameters declined progressively with increase in storage period. The average germination percentage and vigour index of the seed at the beginning of storage period was 99.10 per cent and 3556, respectively, which declined to 90.71 per cent and 1766.71, respectively at the end of 12th month of storage. This gradual decline in the quality of seeds during storage may be due to ageing effects, leading to depletion of food reserves a part from death of seeds because of insect infestation and fungal invasion. These results are in confirmation with Paneru *et al.* (1993) in wheat and Biradar patil and Malbasari (2011) in maize.

Among the various treatments, *Acorus calamus* and Karanj oil were found to be superior in maintaining seed quality through out the storage period over control. The seeds treated with *Acorus calamus*@ 10 ml per kg of seed recorded significantly higher seed quality

Table 1 : Effect of botanicals and insecticides as seed treatment on germination and vigour of paddy seeds

Sr. No.	Treatments	Germination percentage				Seedling vigour index			
		3 MAST	6 MAST	9 MAST	12 MAST	3 MAST	6 MAST	9 MAST	12 MAST
T_1	Emamectin benzoate 5 SG @ 2 ppm (40.0 mg/kg seed)	94.67	92.3	98.00	97.33	2853	755	2536	1836
T_2	Deltamethrin 2. 8 EC @ 1.0 ppm (0.04 ml/kg seed)	96.67	96.3	98.00	96.33	2040	1137	2403	1955
T_3	*Neem* Azal 10000 ppm @ 1.5 ml/ kg seed	91.00	85.3	92.00	86.67	2476	903	2291	1630
T_4	Karanj (P*ongamia pinnata)oil* @ 5ml/kg seed	95.33	87.0	97.00	90.33	2943	1159	2252	1853
T_5	Citronella oil @ 5ml/kg seed	96.00	81.7	92.33	87.33	2653	905	2299	1688
T_6	*Acorus calamus* @ 10 ml/kg seed	96.00	89.7	95.33	96.33	2778	1110	2376	1947
T_7	Untreated control	96.67	91.0	95.33	80.67	3037	1229	2204	1458
	C.D. (P=0.05)	7.95	8.5	2.50	5.6	NS	NS	181.5	176.9

NS=Non-significant

Table 2 : Effect of botanicals and insecticidesas seed treatment on per cent seed damage and moisture content of paddy seeds

Sr. No.	Treatments	Per cent seed damage				Moisture percentage			
		3 MAST	6 MAST	9 MAST	12 MAST	3 MAST	6 MAST	9 MAST	12 MAST
T_1	Emamectin benzoate 5 SG @ 2 ppm (40.0 mg/kg seed)	0.8	1.0	3.2	4.2	12.9	9.8	9.27	9.17
T_2	Deltamethrin 2.8 EC @ 1.0 ppm (0.04 ml/kg seed)	0.3	1.3	2.1	3.0	12.5	9.8	9.17	9.23
T_3	Neem Azal 10000 ppm @ 1.5 ml/ kg seed	0.5	7.8	4.9	5.37	12.3	9.7	8.80	9.10
T_4	Karanj (*Pongamia pinnata)oil* @ 5ml/kg seed	0.7	1.2	4.7	5.3	12.4	9.7	9.27	9.20
T_5	Citronella oil @ 5ml/kg seed	0.5	4.3	7.8	9.2	12.6	9.6	8.67	9.20
T_6	*Acorus calamus* @ 10 ml/kg seed	0.6	1.0	1.0	8.00	12.5	9.3	9.30	9.30
T_7	Untreated control	3.9	10.7	17.2	18.2	13.2	9.6	8.67	9.17
	C.D. (P=0.05)	1.57	2.2	2.4	6.49	4.35	0.2	0.35	NS

NS=Non-significant

parameters followed by other botanicals. From third month on ward still the end of storage, these edstreated with *Acorus calamus*@ 10 ml per kg seeds (T_6) recorded significantly higher values for germination and seedling vigour index (Table 1) while lower values for seed infestation indicating superiority of this treatment over control in maintaining these ed quality in storage. These results are in accordance with the findings of Deshpande *et al.* (2004) in black gram and Singh *et al.* (2006) in pigeonpea.

The other botanical, Karanj oil also recorded higher germination (90.33) and vigour index (1853) over untreated control. These results are in conformity with the reports of Merwade (2000) and Kumbar (1999) inchickpea.

The insectic idal property present in these botanicals also helped the seeds to be incompatible for insects attack during storage (Prakash and Jagadishwari Rao, 1992). Further, the botanicals might also possess the phyto tonic effect resulting in higher seed quality parameters. Similar beneficial effect was observed in *Acorus calamus* in protecting these eds from the attack of *Sitotroga cerealella* (Angoumois grain moth) through out the storage period.

In the present study, these eds treated with organics namely *Acorus calamus* and Karanj oil recorded lower seed infestation percentage and are at par with deltamethr in (3.0%) indicating the possibility of use of these botanical sin controlling the insect infestation in storage. Similar beneficial effect of botanicals in controlling insect attack during storage has been observed by Maraddi (2002) incowpea, Umrao and Verma (2002) in pea seeds. Further, the main advantage of treating seeds with botanicals over chemicals is that, the seeds treated with botanicals if left can be re used for consumption purpose after washing with water. Whereas, it is not possible in the seeds treated with the chemicals due to residual toxic effect on human beings and animals.

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