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RESEARCH ARTICLE

Potential of plant material as protectant to wheat seed against grain weevil (*Sitophilus oryzae* L.)

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ABSTRACT

The various plant material *viz.*, Neem leaves (*Azadiracta indica)*, Vekhand powder (*Acorus calamus*), Jangli Imli powder (*Phyllanthus niruri*) and Giloe (*Tinospora cordifolia*) 10 g each per kg seed alone and in combination with each other @ 5g+ 5g each and untreated control were tested against grain weevil infesting wheat seed. The observations on per cent reduction of population of grain weevil, weight of grains at 15 days interval, after 45 days after inoculation up to 180 days, per cent infestation of seed by grain weevil, seed germination and seedling vigour index at 180 days after inoculation were recorded. Among the various plant materials, the seed treatment with Vekhand powder @ 10 g/kg seed was found most effective and promising in reducing the per cent grain weevil population (99.21 %) and maintained highest seed weight (0.964 g), lowest per cent infestation of seed (0.30%), maximum germination of seed (88.75%) and highest seedling vigour index (87.76%).

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INTRODUCTION

The role of chemical insecticide is more important for control of storage pests. However, these chemicals are hazardous to human beings. Unused treated seed become unfit for human consumption and cattle feeding. Besides this, insects also develop resistance to insecticide. Among the cereals, wheat is the most advantageous and pivotal crop of the country. It is the second most important food crop of India, which contributes nearly one third of the total food grain production (Anonymous, 2012).

Wheat is stored by the farmers and government agencies for its utilization throughout the year. Use of quality seed is the most essential input in crop protection as it maintains the optimum plant population in field.

Among the several insects attacking stored grains, *Sitophilus oryzae* L. has got economic importance. It is the most destructive insect pest of the stored raw cereal grains in the world (Champ and Dyte, 1976). *Sitophilus oryzae* causes substantial losses to stored grain amounting 18.30 per cent (Adams, 1976). This species has a relatively short developmental period and high population can easily be built up (Aitken, 1975). Rice weevil (*S. oryzae* L.) has been reported as one of the severe pests of cereal grains (Baloch, 1992). Efforts were made for effective and complete control of store grain pests through insecticides but there was no success. For control of stored pests, different methods are used. Use of insecticides is one the methods used for control of store grain pests which is widely odopted. None of these methods and products can be declared as safe to the human beings, birds and beneficial insects (Metcalf, 1982). There is need to find the alternatives to the chemicals that can effectively prevent the storage losses, safer to the human beings and ecofriendly. The products obtained from plants can be used without risk to non-target organisms. Very little research work and information is available on use of plant extracts on the insect pests of stored grains, particularly on *S. oryzae*. Hence,

the present study was conducted to find the effective plant material against *S.oryzae* in the stored wheat grains.

MATERIAL AND METHODS

A laboratory experiment was conducted at Agricultural Research Station, Niphad dist. Nasik during three consecutive years from 2006-07, 2007-08 and 2008-09 in Completely Randomized Design having eleven treatments and three replications. Neem leaves (*Azadiracta indica*), Vekhand powder (*Acorus calamus*), Jangli Imli powder (*Phyllanthus niruri*) and Giloe (*Tinospora cordifolia*) 10 g each per kg seed alone and in combination with each other @ 5g+ 5g each were compared with untreated control. Freshly harvested 1 kg wheat seed (NIAW 301) with very high germination percentage and low moisture contents was taken in cloth bags. Seed was treated with various plant materials before inoculation of grain weevil in each treatment. Five pair of adults of *S.oryzae* was inoculated in each treatment. Observations were taken at 45 days after inoculation of insects and continued fortnightly up to 180 days. The counts of the insects were taken at each 15 days interval and the dead insects were removed. The data of the per cent reduction in the insect population over untreated control were worked out. The weight of seed grains was taken at the same interval. The observations on per cent germination and per cent infestation of seed were also recorded at180 days after inoculation. The statistical analysis was done by using Completely Randomized Design (CRD).

RESULTS AND DISCUSSION

The pooled data for consecutive three years (2006-07, 2007-08 and 2008-09) pertaining to effect of various plant materials as seed protectant to wheat seed against grain weevil (*S. oryzae* L.) are depicted in Table 1 to 3. The data indicated significant differences among the treatments.

Per cent reduction of grain weevil :

The pooled data of Table 1 indicated that the seed treatment with Vekhand powder and its combinations with Neem leaves, Jangli Imli and Gulwel powder proved to be significantly effective in controlling the population of grain weevil (*S. oryzae*)

Table 1 : Effect of various plant materials as seed protectant of wheat seed on per cent reduction of grain weevil (*S.oryzae*)

Sr. No.	Treatments	Dose g/kg seed	% Reduction of grain weevil over untreated control									
			45 DAI	60 DAI	75 DAI	90 DAI	105 DAI	120 DAI	135 DAI	150 DAI	165 DAI	180 DAI
1.	Neem leaves	10	18.48	23.73	23.34	11.55	7.80	5.92	22.74	17.14	21.71	28.47
	(*Azadiracta indica)*		*(25.48)	(29.13)	(28.86)	(19.91)	(16.22)	(14.06)	(28.45)	(28.45)	(27.76)	(32.27)
2.	Vekhand powder	10	94.29	94.73	96.27	96.61	98.54	98.70	99.21	99.00	99.33	99.21
	(*Acorus calamus*)		(76.19)	(79.69)	(78.91)	(79.37)	(82.96)	(83.45)	(84.32)	(84.26)	(84.25)	(84.32)
3.	Jangli Imli powder	10	36.02	39.10	56.04	48.16	32.15	27.68	41.69	47.76	28.43	25.09
	(*Phyllanthus niruri*) powder		(36.87)	(38.70)	(48.45)	(43.97)	(34.51)	(31.76)	(40.22)	(43.74)	(32.20)	(30.07)
4.	Giloe (*Tinospora cordifolia*)	10	18.17	17.69	26.22	24.22	32.74	20.64	34.17	37.58	22.99	21.00
	/Gulvel powder		(25.25)	(24.88)	(30.79)	(29.47)	(34.88)	(26.99)	(35.79)	(37.82)	(28.66)	(27.28)
5.	Vekhand powder + Neem	5+5	91.50	90.28	94.70	94.16	96.90	95.89	98.22	98.94	97.82	97.33
	leaves		(73.05)	(71.85)	(76.69)	(76.06)	(79.86)	(78.32)	(82.29)	(83.98)	(81.47)	(80.54)
6.	Jangli Imli + Neem leaves	5+5	21.50	24.29	24.29	20.15	12.58	13.69	39.86	14.52	21.66	23.61
			(27.63)	(29.53)	(29.53)	(26.71)	(20.79)	(21.72)	(39.17)	(22.38)	(27.76)	(29.07)
7.	Gulvel powder + Neem	5+5	25.41	31.80	17.88	18.58	17.49	28.81	41.21	14.15	18.98	23.09
	leaves		(30.26)	(34.33)	(25.03)	(25.55)	(24.73)	(32.46)	(39.93)	(22.14)	(25.84)	(29.27)
8.	Vekhand powder + Jangli	5+5	88.78	88.17	96.06	94.13	97.35	86.72	98.67	98.66	99.44	98.29
	Imli		(70.45)	(69.91)	(78.61)	(75.94)	(80.72)	(68.61)	(83.45)	(83.45)	(84.28)	(82.51)
9.	Vekhand powder + Gulvel	5+5	87.27	87.63	94.27	97.01	97.40	97.30	98.86	98.39	98.64	97.91
	powder		(69.12)	(69.38)	(76.19)	(80.02)	(80.72)	(80.54)	(83.98)	(82.73)	(83.20)	(81.67)
10.	Jangli Imli + Gulvel powder	5+5	35.00	32.61	28.62	33.35	32.12	11.39	27.88	12.12	19.40	22.69
			(36.27)	(34.82)	(32.33)	(35.30)	(34.51)	(19.53)	(31.88)	(20.36)	(26.13)	(28.45)
11.	Untreated control	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	S.E. ±		13.08	11.53	14.07	14.29	16.77	17.12	13.96	17.11	13.96	16.21
	C.D. (P=0.05)		35.58	34.07	41.51	42.14	49.47	50.50	41.18	50.50	41.18	47.84

* Figures in parenthesis denote the angular transform values, DAI= Days after inoculation

as compared to rest of the treatments. The seed treatment with Vekhand powder @ 10 g/kg of seed recorded significantly maximum per cent reduction of grain weevil (*S. oryzae*) over untreated control *i.e.* 94.29, 94.73, 96.27, 96.61, 98.54, 98.70, 99.21, 99.00, 99.33 and 99.21 at 45, 60, 75, 90, 105, 120, 135, 150, 165 and 180 days after inoculation, respectively as against zero per cent reduction in untreated control. It was statistically at par with the treatments of Vekhand powder + Neem leaves, Vekhand powder + Jungli Imli and Vekhand powder + Gulwel powder @ 5+5 g/kg of seed.

Grain weight :

At 45 DAI, there were no significant differences in weight of grains. The seed treatment with Vekhand powder @ 10 g / kg seed recorded (0.990, 0.991, 0.985, 0.983, 0.981, 0.977, 0.972, 0.971 and 0.964 g) weight of grains at 60, 75, 90, 105, 120, 135, 150 and 180 days after inoculation, respectively. At 180 days after inoculation, Vekhand powder @ 10 g / kg seed recorded highest (0.964 g) weight of grain. However, it was at par with Vekhand powder + Gulvel powder @ 5+5 g/kg seed, Vekhand powder + Jangli Imli @ 5+5 g/kg seed and Vekhand powder +

Table 2 : Effect of various plant materials as seed protectant of wheat seed on weight of grains

Sr. No.	Treatments	Dose g/kg seed	Weight of grains (g)									
			45 DAI	60 DAI	75 DAI	90 DAI	105 DAI	120 DAI	135 DAI	150 DAI	165 DAI	180 DAI
1.	Neem leaves (*Azadiracta indica)*	10	0.956	0.954	0.931	0.911	0.880	0.843	0.815	0.804	0.783	0.773
2.	Vekhand powder (*Acorus calamus*)	10	0.992	0.990	0.991	0.985	0.983	0.981	0.977	0.972	0.971	0.964
3.	Jangli Imli powder (*Phyllanthus niruri*)	10	0.974	0.967	0.938	0.923	0.890	0.849	0.831	0.844	0.801	0.794
4.	Giloe (*Tinospora cordifolia*)/ Gulvel powder	10	0.955	0.947	0.934	0.906	0.873	0.830	0.790	0.782	0.779	0.783
5.	Vekhand powder + Neem leaves	5+5	0.984	0.977	0.971	0.967	0.963	0.961	0.953	0.944	0.941	0.931
6.	Jangli Imli + Neem leaves	5+5	0.960	0.949	0.937	0.920	0.855	0.826	0.808	0.798	0.777	0.761
7.	Gulvel powder + Neem leaves	5+5	0.971	0.954	0.937	0.922	0.862	0.838	0.825	0.816	0.799	0.790
8.	Vekhand powder + Jangli Imli	5+5	0.982	0.979	0.978	0.973	0.963	0.961	0.953	0.949	0.944	0.933
9.	Vekhand powder + Gulvel powder	5+5	0.985	0.982	0.978	0.973	0.965	0.962	0.957	0.951	0.947	0.937
10.	Jangli Imli + Gulvel powder	5+5	0.963	0.955	0.942	0.926	0.862	0.835	0.819	0.807	0.792	0.781
11.	Untreated control	-	0.957	0.938	0.896	0.880	0.829	0.776	0.744	0.728	0.699	0.684
	S.E. ±		0.011	0.011	0.008	0.006	0.012	0.014	0.016	0.030	0.018	0.019
	C.D. (P=0.05)		NS	0.031	0.022	0.017	0.035	0.041	0.045	0.084	0.050	0.054

DAI= Days after inoculation

Table 3 : Effect of various plant materials as seed protectant of wheat seed on per cent infestation of seed, germination and seedling vigour index

Sr. No.	Treatments	Dose g/kg seed	% Infestation of seed by grain weevil	% Germination	Seedling vigour index
1.	Neem leaves (*Azadiracta indica)*	10	37.73 *(37.78)	53.16 (46.83)	24.75
2.	Vekhand powder (*Acorus calamus*)	10	0.30 (4.05)	88.75 (70.45)	87.76
3.	Jangli Imli powder (*Phyllanthus niruri*)	10	29.66 (32.98)	54.83 (47.75)	22.01
4.	Giloe (*Tinospora cordifolia*) / Gulvel powder	10	28.43 (32.17)	56.16 (48.56)	25.80
5.	Vekhand powder + Neem leaves	5+5	0.48 (4.15)	86.16 (68.19)	80.26
6.	Jangli Imli + Neem leaves	5+5	29.05 (32.41)	55.25 (47.98)	26.24
7.	Gulvel powder + Neem leaves	5+5	28.83 (32.46)	54.50 (47.58)	25.35
8.	Vekhand powder + Jangli Imli	5+5	2.28 (8.59)	75.83 (60.53)	62.57
9.	Vekhand powder + Gulvel powder	5+5	3.77 (11.17)	71.16 (57.54)	53.72
10.	Jangli Imli + Gulvel powder	5+5	26.83 (31.12)	53.75 (47.18)	19.65
11.	Untreated control	-	45.33 (42.30)	31.75 (34.33)	13.01
	S.E. ±		0.73	0.95	1.81
	C.D. (P=0.05)		2.03	2.78	5.32

* Figures in parenthesis denote the angular transform values

Neem leaves @ 5+5 g/kg seed which recorded 0.937, 0.933 and 0.931 g weight of seed. The lowest (0.684 g) wheat seed grain was recorded in untreated control (Table 2).

Per cent infestation of seed :

Pooled data presented in Table 3 revealed that the per cent infestation of grain by grain weevil was in range of 0.30 to 45.33 per cent. Significantly lowest (0.30) per cent infestation of seed was recorded in seed treated with Vekhand powder @ 10 g/kg seed. It was at par with Vekhand powder + Neem leaves @ 5 + 5 g/kg seed which recorded 0.48 per cent infestation of seed. The highest (45.33) per cent infested seed was noticed in untreated control.

Germination and seedling vigour index :

Germination test of the different treatments was taken 180 days after storage of seed. Data presented in Table 3 revealed that the maximum germination percentage of 88.75 per cent was found in seed treatment with Vekhand powder @ 10 g/kg seed as against lowest in untreated control (31.75%). Seedling vigour index was maximum of 87.76 in seed treatment with Vekhand powder @ 10 g/kg seed as against lowest in untreated control (13.01).

Among all the plant products used, Vekhand powder alone and in combination afforded maximum protection than any other product. It was highly effective against *S.oryzae* at 10 g/kg seed of wheat seed which recorded highest per cent reduction of population of grain weevil (*S.oryzae*), minimum reduction in weight of seed, lowest per cent infestation of seed and maximum germination per cent and highest seedling vigour index. These findings in respect of Vekhand powder are in agreement with Jilani (1984) who reported that *Acorus calamus* was good grain protectant against *S.oryzae* and *Rhizopertha.* Vekhand powder reduced the seed infestation by *S.oryzae* when used at 0.5 per cent as reported by Tiwari (1993). Sunilkumar (2003) studied that sweet flag was highly protective up to 180 days against *S.oryzae* @ 10 per cent doses showing less than 1 per cent seed damage in sorghum. Yevoor (2003) studied that sweet flag powder @ 2 per cent caused zero per cent grain damage and weight loss and cent per cent adult mortality of *S.oryzae.*

Thus, the present investigation revealed that the wheat seed treatment of Vekhand powder @ 10 g/kg wheat seed was found effective for maintaining the lowest per cent infestation of seed, higher seed germination and highest seedling vigour index.

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