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Effect of Plant Oils on Seed Quality Parameters and Disease Control in Chilli Seeds Infected with *Colletotrichum capsici*

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Abstract

A study was undertaken to find the plant oils as an alternative to fungicides in particular the carbendazim. The plant oils were tested against the carbendazim (2g kg^{-1} seed), in blotter and pot culture methods. The neem oil treatment (5 ml kg^{-1} seed) has resulted in significantly higher seed germination (94.3 % Vs 92.0 % in blotter method and 92.0 % Vs 91.0 % in pot culture), seedling vigour index-I (931.4 Vs 652.3 in blotter method and 913.9 Vs 608.5 in pot culture), seedling vigour index-II (5534.0 Vs 3373.3 in blotter method and 4661.3 Vs 3579.3 in pot culture) and disease control (80.9 % Vs 73.0 % in blotter method and 73.9 % Vs 70.7 % in pot culture). The lower dose of @ 5 ml kg^{-1} seed was effective as compared to the @ 10 ml kg^{-1} seed. Therefore, the neem oil @ 5 ml kg^{-1} seed can be used as an alternative to carbendazim for seed treatment to control the *C. capsici* and related diseases.

Keywords : Plant oils, chilli, blotter method, pot culture, seed germination, seedling vigour, disease incidence

Seed is the carrier of technology from one generation to another. Serving as the first line of defense, seed treatment can improve germination, seedling emergence, crop establishment and plant vigour. Chilli (*Capsicum annum* L.) is a vital spice component in the Indian food. Green chillies are known to possess higher amount of vitamin-C as compared to the citrus. In India, green chillies are grown in an area of 1.70 lakh ha with an annual production of 19.83 lakh tonnes and the productivity of 11.6 t ha^{-1}. The state of Haryana stands 5th in the country in terms of green chilli production after the Karnataka, Bihar, Andhra Pradesh and Jharkand. Haryana has 1.134 lakh tonnes of production with area of 0.17 lakh ha (NHB, 2016). In terms of chilli production, India was in first position in the world and it dropped to third position due to increasing fungal diseases (Sahitya *et al*., 2014; Saxena *et al.*, 2016). Among fungal diseases, seedling rot and fruit rot are very important as they cause yield loss up to 50 per cent (Saxena *et al.*, 2016). The *C. capsici* is more common fungi that cause fruit rot of chilli in tropical and subtropical conditions, resulting in qualitative and quantitative losses (Hemannavar *et al*., 2009; Lydia and Zachariah, 2012; Noireung *et al.,* 2012).

Seed treatment with chemical fungicides is a common practice in the country however, long term usage leads to residual toxicity, induced pathogen resistance and environmental pollution and also side effects on human and animals (Rajavel, 2000). Alternatively, the plant products are natural, low cost, safer and eco-friendly, therefore, to have a safe environment, eco-friendly measures like plant oils could be better option in the climate change scenario. Hence, the present study was formulated with an objective to identify suitable plant oil as an alternative to carbendazim in chilli production system.

Material and Methods

The seeds of high yielding chilli variety (RCH-1) harvested during February-March, 2016 were used in the present investigation. The germination of these seeds before treatment was 79 per cent. Two experiments *viz.,* blotter method in laboratory and pot culture were conducted at the Department of Seed Science and Technology, CCS HAU, Hisar during October-November, 2016. In blotter method, the infected chilli seeds were dressed with different oils separately using two doses *i.e.,* 5 and 10 ml kg^{-1} of seed. The different oils used in the experiment were, castor, neem, aonla, sesamum, linseed, pongamia, walnut and ajwain. The treated seeds were shade dried on blotting paper over night. Then 25 seeds were placed equidistantly in each petri plate lined with two layers of filter paper (Whatman No.1) and 16 petri plates to accommodate 400 seeds for each treatment.

These plates were placed in BOD incubator maintaining the temperature at 25±1°C. The sterilized distilled water was added whenever the blotter paper appeared nearly to dry. After 14 days of incubation, observations were made on seed germination, seedling vigour indices, disease incidence and disease control.

In pot culture experiment, pots (27.5 cm diameter and 30 cm height) were filled with four kg of the oven sterilized soil. The seeds were treated as explained above for blotter method and twenty five seeds were placed at a depth of 1-2 cm in each of the pot with 16 pots per treatment. The pots were watered daily up to 14 days and the weeds were uprooted whenever seen.

Observations were made on 14th day and only normal seedlings were considered for germination percentage. From the randomly selected ten normal seedlings per replication, the seedling length was measured. After taking the seedling length, the same seedlings were kept for drying in oven at 70 ± 1°C until they attained a constant weight. Considering the germination percentage, seedling length and seedling dry weight, the SVI-I was computed as seed germination (%) × seedling length (cm) and; SVI-II as seed germination (%) × seedling dry weight (mg), (Anderson and Baki, 1973). The disease incidence and disease control was calculated in percentage as detailed below.

$$\text{Disease incidence (\%)} = \frac{\text{Number of seedlings effected}}{\text{Total number of seedlings observed}} \times 100$$

$$\text{Disease control} = \frac{\text{Disease incidence in infected control - Disease incidence in treatment}}{\text{Disease incidence in infected control}} \times 100$$

The data obtained was statistically analysed in Completely Randomised Design (CRD) in both the experiments.

Results and Discussion

Effect of plant oils on seed germination

Among plant oils in blotter method, the neem oil treatment @ 5 ml kg^{-1} resulted in highest germination (94.3%) and was on par to the carbendazim treatment (92%). While, ajwain oil @ 10 ml kg^{-1} proved comparable (90.7%) to carbendazim (92.0%). In pot culture also, neem oil @ 5 ml kg^{-1} showed the same germination as that of carbendazim (92%), while at higher concentration (10 ml kg^{-1}) carbendazim performed significantly superior over all other treatments (Table I). The higher germination with oils

Table I

Effect of plant oils on seed germination in Colletotrichum capsici *infected chilli seeds*

Treatments	Germination (%)			
	Blotter method		Pot culture	
	5 ml kg-1 seed	10 ml kg-1 seed	5 ml kg-1 seed	10 ml kg-1 seed
Castor	93.3 (75.0)	84.0 (66.4)	81.0 (64.1)	81.3 (64.4)
Neem	94.3 (67.5)	85.3 (76.2)	92.0 (67.5)	85.3 (73.5)
Aonla	92.0 (73.5)	81.3 (64.4)	89.3 (71.0)	84.0 (66.4)
Sesamum	90.7 (72.6)	84.0 (66.4)	86.7 (68.6)	84.0 (66.4)
Linseed	88.0 (69.7)	84.0 (66.4)	81.3 (64.4)	85.3 (67.5)
Pongamia	86.0 (68.0)	84.0 (66.5)	84.0 (66.5)	85.0 (67.2)
Walnut	92.0 (73.5)	86.7 (68.6)	86.7 (68.6)	85.3 (67.5)
Ajwain	92.0 (73.5)	90.7 (72.2)	86.7 (68.6)	85.7 (67.7)
Infected seed	70.3 (57.0)	70.3 (57.0)	69.3 (56.4)	69.3 (56.4)
Healthy seed	85.3 (67.5)	85.3 (67.5)	83.7 (66.1)	83.7 (66.1)
Carbendazim	92.0 (73.5)	92.0 (73.5)	91.0 (72.5)	91.0 (72.5)
Mean	88.7 (70.91)	84.3 (66.95)	84.7 (67.30)	83.6 (66.33)
CD @ 5%	2.7	2.2	2.4	0.8
SEm±	0.9	0.8	0.8	0.3
CV (%)	2.2	1.9	2.1	0.7

Note : Values in parenthesis are arc sign transformed values for statistical analyses

or carbendazim could be due to suppression of germination and growth of *C. capsici* and thus lead to higher seed germination (Gupta, 2016). However, higher concentrations of plant oils (10 ml kg^{-1}) across the two methods, did not enhance the mean seed germination percentage; rather there was a reduction in 5 ml kg^{-1} (86.7 Vs 84.0 %) in the present study and other reports (Vander Wolf *et al*., 2008; Ajayi *et al*., 2014). Therefore, the neem oil @ 5 ml kg^{-1} seed can be effectively used to enhance the seed germination of infected seed of chilli in place of carbendazim (2g kg^{-1}).

Effect of plant oils on seedling length (cm) and dry weight (mg)

Both in blotter method and pot culture, all plant oils @ 5 and 10 ml kg^{-1} seed, gave significantly higher seedling length compared to the healthy seeds (without seed treatment) and *C. capsici* infected seeds (Table II). The seedling length in blotter method was significantly higher with neem oil treatment @ 5 ml kg^{-1} seed (9.87 cm) as compared to the carbendazim treatment (7.09 cm). In pot culture also, the neem oil treatment @ 5 and 10 ml kg^{-1} (9.93, 8.17 cm, respectively) was significantly superior to the carbendazim (6.68, 6.68 cm, respectively). Similar results of increased seedling length was observed with application of neem/ castor extracts (Nahak and Sahu, 2014).

Seedling dry weight in all the oil treatments (5 ml kg^{-1} seed) except the aonla proved significantly superior to carbendazim (36.7 mg /seedling) and healthy seed (28.0 mg/seedling) in the blotter method. Even in pot culture, the neem (50.7 mg / seedling), aonla and walnut (46.0 mg/seedling each) treatments had significantly higher seedling dry weight than the carbendazim (39.3 mg/seedling). Higher dose of plant oils (10 ml kg^{-1}) decreased the seedling dry weight compared to 5 ml kg^{-1} in blotter method (probably 28.1 Vs 41.0 mg) and pot culture (28.7 Vs 36.5 mg) conditions. This could be due to phytotoxicity, that inhibits the cell elongation, nuclear and organellar DNA synthesis resulting in suppression of seed germination, seedling length and seedling dry weight (Ajayi *et al*., 2014). These results

TABLE II

Effect of plant oils on seedling length and dry weight in Colletotrichum capsici *infected chilli seeds*

Treatments	Seedling length (cm)				Seedling dry wt. (mg / seedling)			
	Blotter method		Pot culture		Blotter method		Pot culture	
	5 ml kg -1 seed	10 ml kg -1 seed	5 ml kg -1 seed	10 ml kg -1 seed	5 ml kg -1 seed	10 ml kg -1 seed	5 ml kg -1 seed	10 ml kg -1 seed
Castor	6.53	8.17	4.62	6.03	39.0	29.7	26.3	26.3
Neem	9.87	9.09	9.93	8.17	58.7	29.0	50.7	35.7
Aonla	7.71	8.48	4.60	4.58	30.0	28.7	46.0	26.7
Sesamum	9.12	8.42	5.31	5.23	47.7	29.7	28.3	26.0
Linseed	9.20	8.37	4.84	5.57	49.3	26.7	35.3	26.3
Pongamia	8.17	7.88	4.48	5.58	48.7	28.0	35.7	23.3
Walnut	9.19	9.16	4.76	5.47	42.0	26.3	46.0	26.1
Ajwain	8.09	8.74	4.64	5.82	45.0	20.7	34.3	26.2
Infected seed	4.69	4.69	4.58	4.58	25.7	25.7	25.7	25.7
Healthy seed	5.94	5.94	5.21	5.22	28.0	28.0	34.3	34.3
Carbendazim	7.09	7.04	6.68	6.68	36.7	36.7	39.3	39.3
Mean	7.75	7.82	5.42	5.72	41.0	28.1	36.5	28.7
CD @ 5%	0.28	0.40	0.23	0.25	2.0	3.1	2.0	2.4
SEm±	0.09	0.13	0.08	0.08	0.7	1.1	0.7	0.8
CV (%)	2.11	3.07	5.26	5.84	2.9	6.5	3.2	4.8

indicate that instead of carbendazim, the neem oil (5 ml kg^{-1} seed) can be effectively used to increase the seedling length and seedling dry weight.

Seedling vigour indices

Neem oil treatment (5 ml and 10 ml kg^{-1} seed) resulted in significantly higher seedling vigour index-I as compared to the carbendazim treatment. At 5.0 ml concentration, SVI-I was 931.4 Vs 652.3 in blotter method and 913.9 Vs 608.5 in pot culture. Even at 10 ml concentration, it was 776.2 Vs 647.7 in blotter method and 697.3 Vs 608.5 in pot culture (Table III). The seedling vigour index-II (SVI-II) was significantly higher in neem oil treatment (@ 5ml kg^{-1} seed) as compared to the carbendazim treatment both in blotter method and pot culture (5534.0 Vs 3373.3 in blotter method and 4661.3 Vs 3579.3 in pot culture). However, SVI-II at higher dose of 10 ml kg^{-1} seed was significantly superior with carbendazim (Table III) which could be due to suppression of germination and growth of *C. capsici* (Gupta, 2016). The mean SVI-II was significantly high at 5 ml kg^{-1} (3398.7) compared to 10 ml kg^{-1} seed (2808.5) although SVI-II did not differ between blotter method and pot culture experiments. Therefore, the present study indicates that the seed treatment with neem oil (5 ml kg^{-1}) is effective in comparison to carbendazim (2g kg^{-1}) in enhancing the seedling vigour and crop stand. Pouyesh (2016) also showed that the seeds treated with carbendazim (0.2%) and neem oil gave higher seedling vigour in paddy.

Effect of plant oils on per cent disease incidence and disease control

The disease incidence was lower with neem and aonla oil treatments @ 5 ml kg^{-1} seed both in blotter method and pot culture experiments (Table IV). In blotter method at 10 ml kg^{-1}, the disease incidence in ajwain oil treatment was low (9.33%) and was on par with carbendazim treatment. However, in pot culture the disease incidence was significantly least in carbendazim treatment over the all the oil treatments. In overall, the disease incidence was least with neem oil treatment and can be attributed to host plant defense

TABLE III

Effect of plant oils on seedling vigour index-I and II in Colletotrichum capsici *infected chilli seeds*

Treatments	Seedling Vigour Index - I				Seedling Vigour Index - II			
	Blotter method		Pot culture		Blotter method		Pot culture	
	5ml kg -1 seed	10ml kg -1 seed	5ml kg -1 seed	10ml kg -1 seed	5ml kg -1 seed	10ml kg -1 seed	5ml kg -1 seed	10ml kg -1 seed
Castor	609.5	686.5	374.5	490.7	3640.3	2491.3	2133.0	2141.7
Neem	931.4	776.2	913.9	697.3	5534.0	2476.0	4661.3	2275.3
Aonla	709.6	689.7	410.5	385.0	2760.0	2334.7	4108.0	2240.0
Sesamum	827.5	707.6	460.9	439.9	4322.7	2492.0	2453.3	2184.0
Linseed	810.2	703.7	393.9	475.3	4341.3	2239.7	2874.7	2247.3
Pongamia	702.5	661.9	376.1	474.3	4184.7	2350.7	2993.3	1984.0
Walnut	845.5	794.5	413.1	467.3	3864.0	2281.7	3986.3	2226.9
Ajwain	744.3	793.0	402.8	498.9	4140.0	1873.7	2975.7	2241.3
Infected seed	329.9	329.8	317.5	317.5	1805.3	1805.3	1779.3	1779.3
Healthy seed	506.9	506.9	436.4	436.7	2389.0	2389.0	2873.0	2873.0
Carbendazim	652.3	647.7	608.5	608.5	3373.3	3373.3	3579.3	3579.3
Mean	697.2	663.4	464.4	481.0	3668.6	2373.4	3128.8	3242.9
CD @ 5%	34.0	41.5	26.8	27.1	216.9	290.7	165.3	220.3
SEm±	11.5	14.0	9.1	9.2	73.5	98.5	56.0	74.6
CV (%)	2.9	3.7	3.4	3.3	3.5	7.2	3.1	5.5

TABLE IV

Effect of plant oils on disease incidence and control (%) in Colletotrichum capsici *infected chilli seeds*

Treatments	Disease incidence (%)				Disease control (%)			
	Blotter method		Pot culture		Blotter method		Pot culture	
	5 ml kg -1 seed	10 ml kg -1 seed	5 ml kg -1 seed	10 ml kg -1 seed	5 ml kg -1 seed	10 ml kg -1 seed	5 ml kg -1 seed	10 ml kg -1 seed
Castor	6.67 (14.95)	16.00 (23.56)	19.00 (25.83)	18.67 (25.59)	77.6 (61.7)	46.0 (42.7)	38.03 (38.1)	39.1 (38.7)
Neem	5.67 (13.75)	14.67 (22.47)	8.00 (16.42)	14.67 (22.51)	80.9 (64.1)	50.5 (45.3)	73.9 (59.3)	52.2 (46.2)
Aonla	8.00 (16.42)	18.67 (25.56)	10.67 (18.98)	16.00 (23.56)	73.0 (58.7)	37.2 (37.5)	65.3 (54.0)	47.8 (43.7)
Sesamum	9.33 (17.35)	16.00 (23.57)	13.33 (21.36)	16.00 (23.57)	68.7 (56. 6)	46.1 (42.7)	56.6 (48.8)	47.8 (43.7)
Linseed	12.00 (20.26)	16.00 (23.56)	18.67 (25.56)	14.67 (22.51)	59.5 (50.5)	46.1 (42.7)	39.2 (38.7)	52.2 (46.2)
Pongamia	14.00 (21.96)	16.00 (23.46)	16.00 (23.46)	15.00 (22.77)	52.8 (46.6)	46.2 (42.8)	48.0 (43.8)	51.1 (45.6)
Walnut	8.00 (16.42)	13.33 (21.41)	13.33 (21.41)	14.67 (22.51)	73.0 (58.7)	55.0 (47.9)	56.5 (48.7)	52.2 (46.2)
Ajwain	8.00 (16.42)	9.33 (17.78)	13.33 (21.41)	14.33 (22.24)	73.0 (58.7)	68.5 (55.9)	56.5 (48.7)	53.3 (46.9)
Infected seed	29.67 (32.99)	29.67 (32.99)	30.67 (33.61)	30.67 (33.61)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Healthy seed	14.67 (22.51)	14.67 (22.51)	16.33 (23.83)	16.33 (23.83)	50.6 (45.3)	50.6 (45.3)	46.7 (43.1)	46.7 (43.1)
Carbendazim	8.00 (16.42)	8.00 (16.42)	9.00 (17.45)	9.00 (17.45)	73.0 (58.7)	73.0 (58.7)	70.7 (57.2)	70.6 (57.2)
Mean	11.27 (19.04)	15.67 (23.03)	15.30 (22.67)	16.36 (23.65)	62.0 (50.9)	47.2 (42.0)	50.1 (43.7)	46.6 (41.6)
CD@5%	2.7	2.69	2.22	2.42	5.4	5.3	5.3	2.1
SEm±	0.9	0.91	0.75	0.82	1.83	1.78	1.78	0.71
CV(%)	2.2	8.29	5.66	6.27	1.83	1.78	1.78	0.71

Note: Values in parenthesis are arc sign transformed values for statistical analyses

mechanism for a longer period by producing phenols and anti-oxidants, which inhibit the fungal mycelia and spore germination (Anand *et al*., 2009).

The mean disease control was markedly high with 5 ml kg^{-1} dose (56.1%) as compared to 10 ml kg^{-1} dose (46.9%). The disease control @ 5 ml kg^{-1} dose was significantly superior with neem oil treatment both in blotter method and pot culture (80.9 and 73.9% respectively) as compared to the carbendazim (73.0 and 70.7% respectively). At higher doses, only carbendazim treatment was significantly superior over all the treatments in both the methods. Since, the disease control was significantly high at 5 ml kg^{-1} compared to the 10 ml kg^{-1} seed treatment, the neem oil treatment @ 5 ml kg^{-1} seed is suggested for disease control.

The experimental results of the present study show that, among the oils tested, seed treatment using neem oil (5 ml kg^{-1} seed) enhances the seed germination, seedling dry weight, seedling vigour index in addition to disease control. The neem oil treatment was comparable or better to that of carbendazim treatment (0.2%). Hence, neem oil (5 ml kg^{-1} seed) can be effectively used to control *C. capsici* and thereby induced diseases.

References

Anand, T., Bhaskaran, R., Raghuchander, T., Samiyappan, R., Prakasam, V. and Gopalakrishnan, C., 2009, Defense responses of chilli fruits to *C. capsici* and *Alternaria altenata*. *Biologia Plantarum,* **53** : 553.

Anderson, J. D. and Baki, A. A., 1973, Vigour determination in soybean seed by multiple criteria. *Crop Sci.,* **13 :** 630 - 633.

Ajayi, O. E., Appel, A. G. and Fadamiro, H. Y., 2014, Phytotoxicity of some essential oils components to cowpea seeds. *Intl. J. Plant Biol. Res*., **2** : 1024 - 1032.

Gupta, V., 2016, Studies on Anthracnose disease of chilli (*Capsicum annuum* L.) caused by *Colletotrichum capsici* (Sydow) Butler and Bisby. *M.Sc. (Agri) thesis*, Department of Plant Pathology, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.)

Hemannavar, V., Rao, M. S. L., Hegde, Y. and Mohankumar, H. D., 2009, Status of seed borne incidence of anthracnose of chilli in northern Karnataka and evaluation of seed health testing method for the detection of *C. capsici*. *Karnataka J. Agric. Sci*., **22 :** 807 - 809.

Lydia, C. and Zachariah, S., 2012, Evaluation of biological, chemical and IDM modules for the management of anthracnose and die-back of chilli. *J. Mycol. Pl. Pathol*., **42** : 435 - 438.

Nahak, G. and Sahu, R. K., 2014, Bio-efficacy of leaf extract of neem on growth parameters, wilt and leaf spot diseases of brinjal. *Res. J. Med. Plant*., **8** : 269 - 276.

NHB, 2016, Area and production of horticultural crops – All India, www.nhb.gov.in, areapro_15-16, Pp.3-4.

Noireung, P., Phoulivong, S., Liu, F., Cai, L., Mckenzie, E. H., Chukeatirote, E. and Hyde, K. D., 2012, Novel species of *Colletotrichum* revealed by morphology and molecular analysis.*Cryptogamie Mycologie,* **33 :** 347 - 362.

Pouyesh, A. J., 2016, Effect of seed treatments on storability of different genotypes of paddy. *Int. J. Multidisciplinary Research and Develop-ment,* **3 :** 142 - 145.

Rajavel, R., 2000, Seed borne *Colletrotrichum capsici* and its management. *M.Sc.(Agri.) Thesis*, TNAU, Coimbatore, Tamilnadu, India

Sahitya, U. L., Deepthi, R., Kasim, D., Suneetha, P. and Krishna, M.S.R., 2014, Anthracnose, a prevalent disease in Capsicum. *Res. J. Pharm. Biological Chemical Sci*., **5** : 1583 - 1604.

Saxena, A., Raghuwanshi, R., Gupta, V. K. and Singh, H. B., 2016, Chilli anthracnose : The epidemiology and management. *Front Microbiol*., **7 :** 1527.

Van Der Wolf, J. M., Birnbaum, Y., Zouwen, P. S. and Groot, S. P. C., 2008, Disinfection of vegetable seed by treatment with essential oils, organic acids and plant extracts. *Seed Sci. Tech.,* **36 :** 76 - 88.

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