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Bio-Pesticide Application for Seed Quality Improvement of Sweet Pepper

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ABSTRACT: A field experiment with eight treatment combinations of bio-pesticide and application methods was conducted to study the efficacy in improving the planting value and maintenance of seed quality of sweet pepper in storage. The studies revealed significant effect of bio-pesticides on seed yield and quality. The bio-pesticides apart from increasing the defence responses of the plants had also increased the seed germination percentage, seedling emergence and growth characteristics. Furrow application with mustard oil cake was most effective for enhancing plant height, fruit number per plant, fruit length and girth, seed number per fruit and yield. Seed treatment and furrow application with jatropha oil was equally effective as furrow application with mustard oil cake. Minimum days to 50 % flowering and fruit setting were observed in seed treatment with jatropha oil and seed treatment and furrow application with jatropha oil respectively and lowest infestation of insects was registered per plant in combined application of insecticide and miticide. Considering the maintenance of seed quality, seed treatment with jatropha oil, seed treatment and furrow application with jatropha oil along with furrow application with jatropha oil and furrow application with mustard oil cake were most promising treatments even after 180 days of storage. These treatments recorded higher germination, root and shoot length, seed vigour index, seed viability and less seed infection than the synthetic pesticidal treatments.

Keywords: Capsicum, Bio-pesticide, Jatropha oil, Mustard oil cake, Application method

India is the largest producer of vegetables next to China with an estimated area and production of 6.71 million hectares and 81.89 million tonnes respectively. The productivity per hectare is 13.16 tonnes [1]. Adoption of recommended production technology and use of high yielding varieties or, hybrids have largely contributed for the enhanced production and productivity of vegetable crops. Capsicum (*Capsicum annuum* L. var. *grossum*), commonly known as sweet pepper belonging to solanaceae family, is a high value low volume crop having high demand both in domestic and export markets. Despite of its economic importance growers are not in a position to produce good quality capsicum with high productivity due to various biotic, abiotic and crop factors like flower dropping, poor fruit set and susceptibility to viral diseases etc. Also it is extensively attacked by a wide array of field and storage pests, which translates into extensive damage, if crop protection measures are not taken at right time. On the other hand, chemical control, which is the only viable management option available to farmers, is expensive and also repeated application is detrimental to both environment and human health. The best alternative of chemical pesticide is bio or botanical pesticide. Botanical pesticide can easily be decomposed by a variety of microbes common in most soils, their use maintained the biological diversity of predators [2], as a result, they reduces environmental contamination and human and animal health hazards. Botanical extracts induces insecticidal, antifungal, antiviral and anti-bacterial activity against pathogens and toxicity to nematodes etc. [3].

In Assam and as well as in other North Eastern region of India, crop yield is very poor in comparison to the other parts of the country due to high rainfall associated with high temperature and infestation by different insect pests, nematodes and mites during the growing season. Hence a study was under taken to investigate the effect of bio pesticide on seed quality of Capsicum during production and storage.

MATERIALS AND METHODS

The field work of the present investigation was conducted with *Capsicum annuum* L. var. *grossum* variety California

Wonder, at the Experimental Farm, Department of Horticulture and laboratory work in Department of Plant Breeding and Genetics, Assam Agricultural University, Jorhat (Assam) during *Rabi* season of 2014-15. AAU Jatropha oil 50 EC and mustard oil cake as bio-pesticides, Imidacloprid and dimethoate as synthetic insecticide and miticide respetively were used for treatments. The experiment was laid out in randomized block design with three replications and eight treatments (Table 1).

Table 1. Seed treatments and procedure

	Treatments	Procedure
T_1	Control	No treatment
T_2	Seed treatment with 5% jatropha oil	5%Jatropha oil was prepared by dissolving 5 ml of AAU jatropha oil 50 EC (formulation) in 95 ml of distilled water. Seeds were soaked in the solution for one hour before sowing.
T_3	Furrow application with 5% jatropha oil	Jatropha oil was applied directly to the furrow before transplanting and mixed well with soil.
T_4	Seed treatment and furrow application with 5% jatropha oil	Combination of T_2 and T_3
T_5	Synthetic insecticide application	Imidacloprid (Confidor) 17.8 SL applied as two numbers of foliar sprayat 10 days interval whenever infestation was found @ 3 ml/lit water.
T_6	Synthetic miticide application	dimethoate (Rogor) applied as two numbers of foliar spray at 10 days interval, whenever infestation was found @ 1 ml/lit water.
T_7	Synthetic insecticide+miticide application	Combination ofT_5 and T_6
T_8	Furrow application with mustard oil cake	Mustard oil cake was applied directly to the furrow @ 900g per 6.4 m^2before transplanting and mixed well with soil.

The experimental field was prepared by following recommended package of practices. The spacing maintained was 60 cm × 45 cm between and within the rows per plot of size 6.4 m^2. Observations were recorded on plant height at 30 and 60 days after transplanting, pest incidence at 30, 60 and 90 DAP, days to 50% flowering and fruit setting, number of fruits per plant, fruit length and girthin cm (by using measuring tape), number of seeds per fruit and yield per plot (g) from randomly selected five plants of each plot. Observation on sucking pest population of mites and aphids (*Myzus persicae*) were recorded by taking count on number of insects per five leaves from five randomly selected plants. For storage, seeds were stored in refrigerator maintained at 4^0C packed in ordinary polythene bags for 0, 60, 120 and 180 days and experiment was laid out in completely randomized design with three replications, each replication with 100 seeds. Observations were taken for germination percentage [4], seed vigour index calculated by multiplying germination percent and mean seedling length of 10 seedlings at final count [5], seed viability, shoot and root length in cm (mean of 10 seedlings) on 0, 60, 120 and 180 days of storage period under ambient condition after harvesting of fruit. Seed health test was conducted by blotter paper method on top paper at 90 and 180 days after storage. The data were analyzed by following the Fisher's method of analysis of variance [6].

RESULTS AND DISCUSSION

Effect of Bio-pesticides on Yield and Yield Attributing Traits

Significant effect of bio-pesticides on plant height (cm) on 30 and 60 DAP, days to 50% flowering and fruit setting, number of fruits per plant, fruit length and girth (cm), number of seeds per fruit, yield per plot (kg) and number of insects specially aphid per plant (relied on' natural incidence) on 90 DAP were observed (Table 2). The treatment of furrow application of mustard oil cake (T_8) was found most effective for enhancing the growth and yield parameters *viz.*; plant height (12.13 and 23.27 cm on 30 and 60 DAP respectively), number of fruits per plant (10 numbers), fruit length (9.23 cm) and girth (10.23 cm), number of seeds per fruit (125.67 numbers) and seed yield per plot (12.23 kg). Seeds treated with 5% jatropha oil (T_2), furrow application with 5% jatropha oil (T_3) and seed treatment and furrow application with 5% jatropha oil (T_4) were found to be at par with T_8 though not in same order for all the traits. Increased yield was due to increased fruit girth, length and number. For early flowering (61.33 days) T_4 and early fruit setting (76.22 days) T_2 were found best but again T_8, T_3, T_2 for early flowering and T_8, T_4, T_3 for early fruit setting were found to be at par with T_4 and T_2 respectively. Beneficial effect of mustard oil cake (MOC) on plant growth and yield had also been reported in rice [7], sunflower [8] and tomato [9]. Hossain *et al.* [10] reported more effectiveness of MOC as fertilizer in

producing cormels and yields of Mukhikachu (*Colocasia esculenta*) than inorganic fertilizers. Highest fruit length in brinjal and fruit yield in banana was observed due to application of MOC compared to chemical fertilizers [11, 12]. This might be due to the presence of high amount of secondary micronutrients in addition to N, P and K @ 5.1-5.2, 1.8-1.9 and 1.1-1.3% respectively in MOC [13]. MOC was also most beneficial as they not only reduce nematode development but also stimulate plant growth by supplying plant nutrients [9]. With 137.67 numbers of insects per plant at 90 DAP, insecticide+miticide application (T_7) followed by insecticide application (T_5) and miticide application (T_6) were found to be the most effective control measures. For other traits except plot yield and fruit length, pesticidal treatments were ineffective and were at par with the control (T_1) which performed poorly with respect to the parameters of plant height at 30 DAP (7.97cm) and 60 DAP (16.53 cm), 50% flowering (71.67 days), fruiting (84.89 days), number of fruits per plant (4.67), fruit length (6.00 cm), fruit girth (7.33 cm), number of seeds per fruit (93.78) and seed yield per plot (6.5 kg).

Effect of Bio-pesticides on Seed Quality

Seed quality evaluation on seed germination, shoot and root length (cm), seed vigour index, seed viability and seed health carriedout at 0, 60, 120 and 180 days of storage revealed no variation among various treatment effects on seed quality till 60 days of storage but at 120 and 180 days significant variation was observed (Table 3 and Table 4). In the present study, over the storage period significant decrease in the germination percentage (from 96.08% to 64.46%) and other germination parameters was observed with the increase in storage duration, however seed infection increased during the same period (2.11% to 3.42%). Natural ageing of seeds may be a factor for reduction in germination percentage which may be accelerated due to the fluctuation of temperature and atmospheric humidity in the ambient storage condition. Changes in seed moisture content may also be one of the factors leading to rapid ageing [14]. Decline in germination percentage may also be associated with biochemical changes occurred in the stored seeds [15]. Pooled analysis over all the storage period revealed highest germination (86.42%) in seed treated and furrows applied with 5% jatropha oil (T_4) though at par with seeds treated with 5% jatropha oil (T_2) with 86.25% and furrows applied with MOC (T_8) with 85.75% germination. Furthermore, the germination was above 80% in bio-pesticides treated seeds even after 180 days of storage where as in inorganic pesticides treated seed, germination was far below than 80%, in control it was only 41.33% at 180 days, indicating that during storage, germination percentage of bio-pesticides treated seeds decreased slowly than inorganic pesticides treated seeds. Nabil e*t al.* [16] also reported increase in wheat seed germination (100%) when treated with crude oil of *Jatropha curcas* @ 0.25 and 0.50 ml while control recorded only 50% germination. This might be due to the composition of oil of *Jatropha curcas* which contains terpenes. These terpenes play an important role in primary process such as photosynthesis, stability of cell membrane and as a source of compounds for several plant hormones [16]. For other seed quality parameters also viz., root (4.71

Table 2. Effect of bio-pesticides on growth and yield characters of *Capsicum annum* L. var*. grossum*

Treatments	Plant height (cm)		Days to 50% flowering	Days to 50% fruit setting	Number of fruit per plant	Fruit length (cm)	Fruit girth (cm)	Number of seed per fruit	Yield per plot (kg)	Number of insect per plant		
	30 DAP	60 DAP								30 DAP	60 DAP	90 DAP
T_1	7.97	16.53	71.67	84.89	4.67	6.00	7.30	93.78	6.50	18.67	207.33	211.67
T_2	12.06	23.21	62.33	76.22	8.00	8.97	9.17	122.67	10.57	11.33	160.67	181.67
T_3	11.07	22.38	62.00	77.89	8.33	8.47	9.93	120.33	10.40	13.00	179.33	186.33
T_4	10.53	22.77	61.33	77.67	9.67	9.00	10.07	122.44	12.13	14.33	173.67	196.33
T_5	8.32	17.05	69.00	83.11	6.00	7.27	7.77	100.78	8.27	10.67	158.33	140.00
T_6	8.47	18.23	67.33	83.13	5.67	7.30	7.93	96.33	8.43	10.33	156.00	147.00
T_7	8.55	18.97	68.00	84.42	6.33	8.13	8.97	100.55	8.77	10.00	180.00	137.67
T_8	12.13	23.27	61.67	76.44	10.00	9.23	10.23	125.67	12.23	11.00	162.00	178.67
SEd(±)	0.88	1.46	2.15	1.21	1.27	0.38	0.90	7.40	1.02	3.18	21.93	12.22
CD (p=0.05)	1.88	3.14	4.62	2.61	2.73	0.82	1.94	15.87	2.19	NS	NS	26.20

NS: Not significant

Table 3. Effect of bio-pesticides on seed quality characters of *Capsicum annum* L. var*. grossum* during storage

Treatments	Germination (%)					Seed vigour index					Seed viability (%)				
Storage period	0 day	60 days	120 days	180 days	Mean	0 day	60 days	120 days	180 days	Mean	0 day	60 days	120 days	180 days	Mean
T_1	92.67	85.33	60.00	41.33	69.83	530.27	505.70	284.57	181.13	375.42	92.67	87.33	64.00	45.33	72.33
T_2	96.33	90.00	83.33	75.33	86.25	699.47	611.93	626.20	503.67	610.32	98.00	92.00	82.67	74.67	86.83
T_3	97.33	90.67	76.67	72.00	84.17	714.00	652.33	566.73	472.93	601.50	99.33	92.00	78.67	74.00	86.00
T_4	98.33	92.67	82.00	72.67	86.42	855.43	759.60	697.00	545.13	714.29	99.33	94.67	85.33	77.33	89.17
T_5	95.00	88.00	66.33	59.33	77.17	563.83	486.63	384.50	300.47	433.86	96.67	90.00	68.67	63.33	79.67
T_6	95.33	88.67	67.33	60.67	78.00	543.37	478.60	376.57	316.90	428.86	97.33	90.67	69.33	64.00	80.33
T_7	96.00	89.33	68.67	61.00	78.75	707.27	627.67	475.10	328.23	534.57	96.67	91.33	70.67	64.67	80.83
T_8	97.67	91.33	80.67	73.33	85.75	840.33	687.53	612.90	521.10	665.47	99.33	93.33	84.00	75.33	88.00
Mean	96.08	89.50	73.13	64.46	80.79	681.75	601.25	502.95	396.20	545.53	97.42	91.42	75.42	67.33	82.90
SEd(±)	2.42	3.53	3.11	5.00		131.68	208.18	62.50	47.02		2.08	3.52	3.11	4.81	
CD (Treat) (p=0.05)	NS	NS	6.66	10.72	2.11	NS	NS	134.07	100.86	35.67	NS	NS	6.66	10.33	1.24
CD (Days) (p=0.05)			1.49					25.22					0.88		

NS: Not significant

Table 4. Effect of bio-pesticides on seed quality characters of *Capsicum annum* L. var*. grossum* during storage

Treatments	Root length (cm)					Shoot length (cm)					Seed infection (%)		
Storage period	0 day	60 days	120 days	180 days	Mean	0 day	60 days	120 days	180 days	Mean	90 days	180 days	Mean
T_1	3.37	3.30	2.37	2.03	2.77	2.37	2.63	2.37	2.33	2.42	6.33	9.93	8.13
T_2	4.13	4.07	4.00	3.33	3.88	3.13	2.73	3.50	3.37	3.18	3.43	4.67	4.05
T_3	4.17	4.10	4.03	3.40	3.92	3.17	3.10	3.37	3.20	3.21	3.87	5.53	4.70
T_4	5.10	4.93	4.83	3.97	4.71	3.60	3.27	3.67	3.53	3.52	3.93	4.87	4.40
T_5	3.47	3.27	3.07	2.73	3.13	2.47	2.27	2.73	2.33	2.45	6.90	8.27	7.58
T_6	3.23	3.17	3.13	2.80	3.08	2.47	2.23	2.47	2.40	2.39	5.63	8.27	6.95
T_7	4.27	4.03	3.63	2.93	3.72	3.10	3.00	3.30	2.43	2.96	4.73	7.47	6.10
T_8	5.03	4.27	4.13	3.80	4.31	3.57	3.27	3.47	3.30	3.40	3.97	5.57	4.77
Mean	4.10	3.89	3.65	3.13	3.69	2.98	2.81	3.11	2.86	2.94	4.850	6.821	5.84
SEd(±)	0.65	0.59	0.62	0.60		0.47	0.59	0.36	0.32		0.98	1.59	
CD (Treat) (p=0.05)	NS	NS	1.34	1.28	0.30	NS	NS	0.77	0.69	0.31	2.11	3.42	0.76
CD (Days) (p=0.05)			0.22					0.22				0.379	

NS: Not significant (T1= Control without any treatment, T2= Seeds treated with jatropha oil, T3= Furrows applied with jatropha oil,

T4= Seeds treated and furrows applied with jatropha oil, T5= synthetic insecticide application, T6= synthetic miticide application, T7= Insecticide + miticide application, T8= Furrows applied with mustard oil cake)

cm) and shoot length (3.52 cm), SVI (714.29), seed viability percentage (89.17%) after 180 days of storage, seed treated and furrows applied with 5% jatropha oil (T_4) was found best. T_4 was at par with T_8 for seed viability (88%) and shoot length (3.4 cm), with T_2 for seed viability (86.83%) and with furrow application with 5% jatropha oil (T_3) for shoot length (3.21 cm). The enhancement in seed vigour index was due to high germination percentage and seedling length.Positive effect of the application of aqueous extract of *J. curcas* for the root length in *Brassica napus*, seedling growth in cauliflower and shoot length in chilli pepper had been also reported [17 - 19]. Selanon *et al.* [19] reported that protein hydrolysate obtained from enzymatic digestion of protein isolated from *J. curcas* seed cake produced higher growth in chilli than a commercial plant growth promoter. At the end of the storage period, T_2 showed least infection though at par with T_4, T_3 and T_8 again indicating effectiveness of bio-pesticides over synthetic pesticide in controlling storage pathogen. The significant influence of bio-pesticides on seed health during storage reducing fungal infestation more effectively than synthetic insecticide treated seeds might be due to antioxidant, antimicrobial and antifungal nature of jatropha oil [20].

CONCLUSION

The most effective treatment for improving crop growth, fruit and seed yield and seed quality parameters of capsicum was furrow application of mustard oil cake (T_8) @ 900 g per 6.4 m^2. The 5% jatropha oil treatment of seeds (T_2), furrow application (T_3) and treatment of both seeds and furrows (T_4) were also found as effective as T_8 for enhancement of fruit and seed yield. Though to control insect pest, synthetic insecticide application (T_5), synthetic miticide application (T_6), combination of synthetic insecticide+miticide application (T_7) were found more effective than other treatments. T_4 along with T_2, T_3 and T_8 were most promising treatments for maintenance of seed quality even at 180 days of storage. Hence itcould be concluded that application of bio-pesticides as seed treatment and soil application enhanced the seed yield and quality of capsicum besides improving the defence responses to pest and diseases infection.

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REFERENCES

1. SWARUP V (1977). Breeding for cross pollinated vegetable crops. ICAR Publ., New Delhi, pp: 50.
2. GRAINGA M AND S AHMED (1988). Handbook of plant with pest control properties. (1st Edn. ISBN: 0471632570), pp: 450-480, Johan Wiley and Sons, New York.
3. PRAKASH A AND J RAO (1997). Botanical pesticide in agriculture, (Sixth Ed.), pp: 288-289, CRC Press Publishing Co., New Delhi.
4. ISTA (1985). International rules for seed testing. *Seed Science Technology,* **13**: 356-513.
5. ABDUL-BAKI AA AND ANDERSON JD (1973). Vigour determination in soybean seed by multiple criteria. *Crop Science*, **13**: 630-633.
6. SNEDECOR GW AND WG COCHRAN (1967). Statistical Methods. Oxford and IBH
7. ISLAM MM, MP ANWAR, M RAHAMAN AND AKMM ISLAM (2007). Influence of mustard oil cake on the performance of fine rice cv. Chinigura. *International Journal of Biological Research,* **3**(6): 50-54.
8. ANIS M, MJ ZAKI AND M DAWAR (2010). Effect of oil seed cake alone or in combination with *Trichoderma* species for the control of charcoal rot of sunflower (*Helianthus annuus L.*). *Pakistan Journal of Botany*, **42** (6): 4329-33.
9. ALI MR, H MEHRAJ AND AFM JAMALUDDIN (2014). Foliar application of the leachate from vermicompost and mustard oil cake on the growth and yield of summer tomato. *Middle-East Journal of Scientific Research*, **22**: 1233-37.
10. HOSSAIN D, M ULLAH, S SHAHJAHAN, MA HAQUE AND M ALI (2009). Effects of organic and inorganic fertilizers on yield and yield contributing characters of Mukhikachu (Colocasia esculenta L.). *The Agriculturists,* **7**(1-2): 50-56.
11. ULLAH MS, MS ISLAM, MA ISLAM AND T HAQUE (2008) Effect of organic manures and chemical fertilizers on the yield of brinjal and soil properties. *Journal of Bangladesh Agricultural University*, **6** (2): 271–276.
12. ZAKARIA M (1992). Effect of mustard oil cake and its method of application on the growth and yield of banana. An M.sc (Ag). Thesis. Dept. of Horticulture, BAU, Mymensingh. pp: 47.
13. ANONYMOUS (I997). Fertilizer Recommendation Guide. BARC, Dhaka Soils pub., No- 4l, **25**: 180.
14. KIBINZA S, D VINEL, D CÔME, C BAILLY AND F CORBINEAU (2006). Sunflower seed deterioration as related to moisture content during ageing, energy metabolism and active oxygen species scavenging. *Physiologia Plantarum*, **128**: 496–506. Retrieved from doi:10.1111/j.1399-3054.2006.00771.x
15. MAITI RK AND S MORENO-LIMON (2001). Seed and seedling traits in bean *(Phaseolus vulgaris* L.) and its relation to abiotic stress resistance. *Legume Research,* **24**(4): 211-221.
16. NABIL AE AND AM KHALIFA YASSER (2012). *Jatropha Curcas* oil as insecticide and germination promoter. *Journal of Applied Sciences and Research*, **8** (2): 668.
17. BONAMIGO T, PSS SILVA, J SILVA, MC POLISKUK AND AMT FORTES (2009). Allelopathic effect of aqueous extract of Jatropha roots in germination and early development of soybean and canola. Anais XII Brazilian Plant Physiology Congress. Fortaleza, CE. *Society Brazilian Plant Physiology*, SBFV, pp: 1.

18. NADALETTI WC, RA BARICCATTI, RF SANTOS, SNM DESOUZA, J AONELLI, PA CREMONEZ, E DEROSSI AND F TOMASSONI (2014). Influence of leaf extract of *Jatropha curcas* on initial growth of cauliflower (*Brassica oleracea* var. Botrytis). *Journal of Agricultural Research,* **9:** 521-526.

19. SELANON O, P JITAREERAT AND W SUNTORNSUK (2009). Plant growth promotion by protein hydrolysate obtained from enzymatic digestion of protein isolated from *Jatropha curcas* seed cake. *Agricultural Science Journal*, **40**: 345-348.

20. ADEBOWALE KO AND CO ADEDIRE (2006). Chemical composition and insecticidal properties of the underutilized *Jatropha curcas* seed oil. *Agricultural Science Journal*, **40**: 345-348.