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Evaluation of Germination on Treated Cowpea Seeds

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ABSTRACT

Seed protectants made from chemicals are commonly used to manage pests in stored pulses. However, these chemicals pose risks to both living organisms and the growth of treated seeds. Therefore, using botanicals for seed treatment is important to ensure germination. Recent research has examined the effectiveness of cashew nut shell liquid as a seed protectant against bruchids. The study aimed to assess how cashew-based treatments affect the germination of treated seeds. Germination studies were conducted using DC-15 cowpea seeds at the soil and water testing laboratory of KVK, Kollam, during 2021-2022. All the cashew-based treatments resulted in higher germination percentages compared to untreated seeds. However, a slight decrease in germination was observed with higher concentrations of cashew treatments during the initial stages. Nevertheless, there were minor differences in germination parameters such as seedling length, seed vigor index, and speed of germination among the treatments.

Key Words: Cashew nut shell liquid, Cowpea, Germination, Protectant, Seed.

INTRODUCTION

Cowpea is an essential pulse crop which is cultivated mostly in tropical and subtropical areas of the world for vegetables, cereals, and as a fodder crop. It is popularly known as poor men's protein source. It is one of the most adaptable pulse crop due to its smothering nature, resistance to drought, ability to restore soil and other multipurpose uses (Oyewale and Bamaiyi, 2013).

Cowpea, however, is prone to insect pests during all stages of growth, including maturation and storage. The pests that cause the most damage are those that appear during the flowering and podding stages, such as the flower thrips, pod borers, and complex of pod and seed sucking pests, as well as the storage pest, bruchids. Pest control programmes using insecticides in various crops around the world unfortunately caused significant environmental harms, pest resurgence, resistance to insecticides, and lethality to non-target organisms, necessitating the introduction of alternatives to harmful insecticides (Oyewale and Bamaiyi, 2013).With benefits like low mammalian toxicity, low risk of pest resistance and pest resurgence, less hazards to non-target organisms, no adverse effect on plants, seed viability, less expensive and easy availability, botanical pesticides are a significant substitute for the use of toxic chemical pesticides (Prakash *et al*, 2008).

Cashew nut shell liquid (CNSL), a byproduct of cashew processing industry, that reported to possess insecticidal property is gaining attention among botanical pesticides. The highly reactive phenolic compounds in CNSL attributes to the insecticidal and fungicidal properties as well as provide excellent preservative effect on timbers, books and stationary to prevent the attack of insects (Gowri and Saxena, 1997). In the present study the effect of CNSL based botanicals on the germination parameters of the treated cowpea seeds was evaluated.

MATERIALS AND METHODS

Germination studies were conducted using grain cowpea seeds of variety DC 15 collected from progressive farmer of KVK, Kollam, The study was conducted at the soil and water testing laboratory of KVK Kollam during the year 2021-2022. The treatments included crude CNSL and CNSL 20 % EC formulation at three different concentrations (2, 4 and 6 mL/kg seed), crushed cashew nut shell (20 g and 40 g/kg seed) and dry

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powdered rhizome of sweet flag (1%) along with chemical check (Malathion 50 EC 0.06 mL/kg seed) and untreated control. Twenty-five healthy seeds per replication were taken and thoroughly mixed with the respective treatments. Two layers of germination paper were placed in a sterile Petri dish of 9 cm diameter for the germination experiment and was moistened with sterile distilled water. The treated seeds were then evenly distributed on the germination paper maintaining suitable distance between them. Sufficient moisture was maintained throughout the experiment. Seeds treated with distilled water served as untreated control (Rawat *et al*, 2018).

Germination

Germination experiment was conducted using cowpea seeds (25 numbers per replication) in a completely randomized block design with 11 treatments and 3 replications. The number of germinated seeds were counted at 1, 2, 3, 4, 5, 6 and 7 DAT. The germination percentage was worked out with the formula proposed by Rajasekaran *et al*. (2017).

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds taken}} \times 100$$

Seedling length

Seedling length was measured on the seventh day after germination with a ruler. Shoot length and root length were measured separately. Shoot length was measured from the tip of the terminal leaf (top most) to the base of shoot while root length was measured from the tip of the primary root to the base of hypocotyls (Dash, 2012). The seedling length was calculated by adding both the shoot and root length and expressed in centimeter (cm).

Seed vigour index I

Seed vigour index 1 was calculated using seedling length and germination percentage. The formula for calculating seed vigour index 1 is as detailed below (Abul-Baki and Anderson, 1973).

Seed vigour index 1 = Germination (%) x Seedling length (cm)

Speed of germination

Speed of germination or germination rate is calculated by the following formula proposed by Maguire (1962). Observations were taken for seven days. The values at each count are added to obtain the germination rate.

$$\text{Speed of germination} = \frac{X1}{Y1} + \frac{X2}{Y2} + \cdots \frac{Xn}{Yn}$$

Where,

Xn – Number of seeds germinated at n^{th} count

Yn – Number of days taken for n^{th} count

RESULTS AND DISCUSSION

Germination

Germination aspects of treated seeds were observed for a period of seven days. It was noted that germination of cowpea seeds were initiated in all the treatments even at 1 DAT. No significant difference was observed in germination percentage of the different treated seeds treatments (Table 1). Among the different botanicals, crushed cashew nut shell at 20 g/Kg seed recorded the highest germination rate (42.67%). This was followed by *A. calamus* 1% (34.67 per cent) and crushed cashew nut shell at 40 g/Kg seed (32.00). The untreated control recorded higher germination per cent of 52.00 and was comparable with the above treatments.

At 2 DAT, cent per cent germination was noticed in untreated control and was statistically similiar with the germination obtained in all other treatments. The observations in botanical treatments *viz*., dry powdered rhizome of *A. calamus* 1% (98.67 %), crushed cashew nut shell at 20 and 40g/Kg seed (93.33 % each), CNSL 20 % EC formulation 2 mL /Kg seed (93.33 %), CNSL 20 % EC formulation 4 mL /Kg seed(90.67 %), CNSL 20 % EC formulation 6 mL /Kg seed(89.33 %), crude CNSL 2 mL /Kg seed (81.33 %) and crude CNSL 4 mL /Kg seed (64.00 %) were recorded.

At 3 DAT, seeds treated with dry powdered rhizome of *A. calamus* 1%, crushed cashew nut shell at 20g/Kg seed and CNSL 20 % EC formulation 2 mL /Kg seed attained cent per cent germination and was comparable with crushed cashew nut shell at 40g/Kg seed, CNSL 20 % EC formulation 4 mL /Kg seed, crude CNSL at 2 mL /Kg seed, crude CNSL at 4 mL /Kg seed and

CNSL 20 % EC formulation 6 mL /Kg seed with germination percentages of 98.67, 98.67, 98.67, 97.33 and 97.33, respectively. Malathion 50 EC recorded the lowest germination per centage (88.00) and was found to be on par with crude CNSL 6 mL /Kg (93.33 %)

Crude CNSL 2 mL /Kg seed, CNSL 20 % EC formulation 2 and 4 mL /Kg seed, crushed cashew nut shell at 20 and 40g/Kg seed and dry powdered rhizome of *A. calamus* 1% attained cent per cent germination of treated seeds at 4 DAT. This was on par with crude CNSL at 4 mL /Kg seed and CNSL 20 % EC formulation at 6 mL /Kg seed with germination percent of 98.67 each and was significantly different from all other treatments. Crude CNSL at 6 mL /Kg seed recorded comparatively lower germination (96.00 %) and was significantly different from all other treatments. The lowest germination per cent of 89.33 was observed in chemical check, malathion 50 EC.

At 5 DAT, cent per cent germination was observed in all treatments except in crude CNSL at 6 mL /Kg seed (97.33 %) and chemical check (90.67%), while both the treatments were significantly different from each other. At 6 and 7 DAT, no significant difference was observed among the treatments since all the treatments recorded cent per cent germination except the chemical check, malathion 50 EC (92.00 %).

Seedling length

Root and shoot length of seedlings of treated grain cowpea were measured at 7 DAT (Table 2).Untreated control recorded the highest root length (5.58 cm). Among the botanicals, CNSL 20 % EC formulation 2 mL /Kg seed recorded the highest root length (5.37 cm) and was on par with all other treatments. The lowest root length was registered in malathion 50 EC (4.14 cm). Shoot length was also found higher in CNSL 20 % EC formulation 2 mL /Kg seed (10.33 cm) among the botanicals and was on par with all other treatments. Shoot length was lowest in malathion 50 EC (4.63 cm). Same as above, highest seedling length (15.70 cm) was observed in CNSL 20 % EC formulation 2 mL /Kg seed and was found on par with untreated control (18.60 cm) which in turn was found to be on par with all other treatments. The lowest seedling length was noticed in chemical check, malathion 50 EC measuring 8.73 cm.

Seed vigour index 1

The treatment, CNSL 20 % EC at 2 mL /Kg seed recorded a higher seed vigour index of 1570.00 which was statistically similiar with untreated control and the value being 1860.33. This was followed by CNSL 20 % EC 4 mL /Kg seed and crushed cashew nut shell at 20 g/Kg seed recording a seed vigour index of 1328.00 and 1318.67, respectively and were on par with all the treatments. The lowest seed vigour index was recorded in chemical check, malathion 50 EC with value of 803.16 (Table 2).

Speed of germination

The speed of germination was recorded throughout the observation period and presented in Table 2 where the untreated control recorded the highest speed of germination (19.00) and was on par with crushed cashew nut shell at 20 g/Kg seed (17.33) and dry powdered rhizome of *A. calamus* 1% (16.77), which in turn was on par with crushed cashew nut shell at 40 g/Kg seed (16.23), CNSL 20 % EC formulation 2 mL /Kg seed (15.39), CNSL 20 % EC formulation 4 mL /Kg seed (14.75) and chemical check, malathion 50 EC (14.26). Crude CNSL 6 mL /Kg recorded the lowest germination rate (12.04).

Although the initial germination percentage was lower in the CNSL based treatments, it hiked to over 95% at 3 DAT, and cent per cent germination was achieved in all treatments at 6 DAT with the exception of the chemical check, malathion 50 EC (92.0%). In the study it was observed that reduction in germination was coupled with increase in CNSL content. Raja (2008) reported a similar decline in germination of treated seeds with increase in CNSL dosage. The germination rate of CNSL treated seeds significantly reduced to 90% in CNSL at 6 mL/kg seed while the lower doses recorded 98% germination. CNSL at higher doses (above 6 mL) caused only 88 % germination. The germination in higher concentrations of crude CNSL was lower when compared to CNSL EC formulation at

Table1. Effect of different treatments on germination of Cowpea seeds (DAT)*

Treatments	1 DAT	2 DAT	3 DAT	4 DAT	5 DAT	6 DAT	7 DAT
Crude CNSL 2mL/kg seed	16.00 (22.88)^{de}	81.33 (68.87)^{bcd}	98.67 (85.77)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
Crude CNSL 4mL/kg seed	14.67 (20.81)^{e}	64.00 (53.70)^{cd}	97.33 (84.14)^{a}	98.67 (85.77)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
Crude CNSL 6mL/kg seed	12.00 (19.46)^{e}	58.67 (50.37)^{d}	93.33 (75.20)^{bc}	96.00 (78.46)^{b}	97.33 (82.12)^{b}	100.00 (89.43)	100.00 (89.43)
CNSL 20 % EC formulation 2 mL/kg seed	25.33 (30.12)^{bcde}	93.33 (80.76)^{ab}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
CNSL 20 % EC formulation 4 mL/kg seed	21.33 (27.20)^{cde}	90.67 (72.64)^{abc}	98.67 (85.77)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
CNSL 20 % EC formulation 6 mL/kg seed	17.33 (24.57)^{cde}	89.33 (71.82)^{abc}	97.33 (82.12)^{ab}	98.67 (85.77)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
Crushed cashewnut shell at 20g/kg seed	42.67 (40.78)^{ab}	93.33 (80.76)^{ab}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
Crushed cashewnut shell at 40g/kg seed	32.00 (34.36)^{abcd}	93.33 (77.57)^{ab}	98.67 (85.77)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (75.17)	100.00 (75.17)
Dry powdered rhizome of *Acorus calamus* 1%	34.67 (35.56)^{abc}	98.67 (85.77)^{ab}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
Malathion 50 EC at 0.06 ml/kg seed	25.33 (29.99)^{bcde}	85.33 (67.63)^{bcd}	88.00 (69.73)^{c}	89.33 (71.01)^{c}	90.67 (72.29)^{c}	92.00 (73.57)	92.00 (73.57)
Untreated control	52.00 (46.16)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)^{a}	100.00 (89.43)	100.00 (89.43)
CD(0.05)	(12.255)	(18.961)	(8.106)	(4.709)	(3.424)	N/S	N/S

*DAT- Days after treatment *Mean of three replications Figures in parenthesis are angular*

similar dose. This might have resulted by the higher amount of phenolic compounds in crude CNSL than in 20 % CNSL EC formulation. Asawalam and Anaeto (2014) found significantly higher germination percentage in cowpea seeds treated with botanicals *viz*., *Curcuma longa* L., *Allium sativum* L., *Zingiber officinale Roscoe* , *Garcinia kola Heckel* and Ficus *exasperate Vahl*) while the control recorded the least germination percentage (35 per cent). Kashere *et* (2015) also reported that germination of cowpea seeds was not affected by n- hexane, pet-ether, acetone, steam distillate methanol and ethanol extracts of cashew kernel. Significant difference in seedling length between botanical treatments, chemical check and untreated control was evident from the observations. All the botanical treatments containing CNSL showed a reduced seedling length (ranging from 9.28 – 15.70 cm) than untreated control (18.60 cm), however the seedling length was significantly higher compared to chemical check, malathion 50 EC (8.73 cm).

Table 2. Effect of different treatments on seedling length, seed vigour index I and speed of germination.

Treatment	Root length (cm)	Shoot length(cm)	Seedling length(cm)	Seed vigour index I*	*Speed of germination
Crude CNSL 2 mL/kg seed	4.94^{abcd}	6.62^{cd}	11.57^{cd}	1156.67^{cd}	13.68^{def}
Crude CNSL4 mL/kg seed	5.22^{abc}	6.04^{cd}	11.26^{cd}	1126.33^{cd}	12.75^{ef}
Crude CNSL6 mL/kg seed	4.26^{cd}	5.02^{cd}	9.28^{cd}	928.33^{d}	12.04^{f}
CNSL 20% EC formulation 2mL/kg seed	5.37^{ab}	10.33^{ab}	15.70^{ab}	1570.00^{ab}	15.39^{bcde}
CNSL 20% EC formulation 4mL/kg seed	4.82^{abcd}	8.46^{bc}	13.28^{bc}	1328.00^{bc}	14.75^{bcde}
CNSL 20% EC formulation 6mL/kg seed	4.24^{d}	5.81^{cd}	10.05^{cd}	1005.00^{cd}	14.14^{cdef}
Crushed cashew nut shell at 20g/kg seed	4.93^{abcd}	8.26^{bc}	13.19^{bc}	1318.67^{bc}	17.33^{ab}
Crushed cashew nut shell at 40g/kg seed	4.31^{cd}	6.24^{cd}	10.54^{cd}	1054.33^{cd}	16.23^{bcd}
Dry powdered rhizome of *Acorus calamus* 1%	4.52^{bcd}	7.60^{bcd}	12.12^{bcd}	1212.00^{bcd}	16.77^{abc}
Malathion 50 EC at 0.06mL/kg seed	4.14^{d}	4.63^{d}	8.73^{d}	803.16^{d}	14.26^{cdef}
Untreated control	5.58^{a}	13.02^{a}	18.60^{a}	1860.33^{a}	19.00^{a}
CD (0.05)	(0.972)	(3.445)	(3.714)	(369.062)	(2.682)

Mean of three replications cm-centimeter

Reduction in seedling length of cowpea seeds treated with different concentrations of CNSL was also reported by Raja (2008) where, CNSL treatments at doses more than 6 mL/kg seed affected the seedling length when the germination test was carried out after six months of storage. None of the botanical treatments adversely affected the seed vigour except crude CNSL 6 mL/kg seed (928.33) and chemical check, malathion 50 EC (803.16). A maximum seed vigour index of 1860.33 was observed in untreated control and was found statistically similar to that of CNSL 20 % EC at 2 mL/kg seed (1570.00) which in turn were found to be on statistically comparable with all other treatments and the values ranged from 1005.00 to 1328.00. Seed treatment with higher concentrations of CNSL resulted in decreased seedling vigour in cowpea, redgram and black gram seeds (Raja, 2015; Raja and Sivasubramaniam, 2015).

Crushed cashew nut shell at 20g/ kg seed recorded the highest speed of germination among the botanical treatments (17.33). This was on par with dry powdered rhizome of *A. calamus* 1% (16.77) and crushed cashew nut shell at 40g/ kg seed (16.23). Speed of germination was comparatively lower in crude CNSL than in CNSL 20 % EC formulations. Matias *et* (2017) reported that the germination percentage, rate of germination and the seedling growth of CNSL treated seeds depend not only on the dose but also on the physiology of the tested species.

CONCLUSION

Although all treatments recorded higher germination of treated seeds and did not differ significantly from each other, seedling length, seed vigour index and speed of germination differed slightly among the treatments. Increase in the concentration of CNSL treatments affected the germination parameters in comparatively low range. Considering the germination aspects, crude CNSL at lower concentrations (2 and 4 mL /Kg seed) and CNSL 20 % EC at higher concentrations (4 and 6 mL /Kg seed) can be recommended for eco friendly management of bruchids in storage.

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