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Full Length Research

Agronomic performance evaluation of cowpea seeds holed by the cowpea seed bruchids, *Callosobruchus maculatus* (F.) in the screen house

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ABSTRACT: Agronomic performance of Oloyin cowpea seeds holed by *Callosobruchus maculatus was* evaluated at the Department of Crop, Soil and Pest Management, Federal University of Technology, Akure, Nigeria. Seeds with emergent holes (1, 2, 3 and 4) and seeds without holes were separately sown in five litre plastic buckets filled with sandy loam soil in the screen house and replicated three times. Data on percentage emergence, number of leaves, number of branches, plant height, plant girth, number of pods, number of seeds per pod, pod length and weight of seeds were collected fortnightly for eight weeks and subjected to analysis of variance. Percentage seedling emergence (20%) obtained from seeds with 4 emergent holes was significantly ($p<0.05$) lower than 86.70% obtained in seeds with one emergent hole. Seeds with 4 emergent holes recorded significantly lower growth parameters. The number of pods were not significantly ($p>0.05$) affected by the number of emergent holes at 6 and 8 weeks after sowing. Total number and weight of seeds per plot were not significantly different ($p>0.05$). The study showed that although the agronomic performance of seeds with ≥3 emergent holes was affected during early stage of growth, there were compensatory effects after establishment. Therefore, based on the findings of this study, it is recommended that seeds with ≤4 bruchids emergent holes that are rejected for consumption could be planted instead of total discard.

Keywords: Agronomic performance, cowpea seeds, *Callosobruchus maculatus,* emergent hole.

INTRODUCTION

Legumes occupy a prominent place in the nutrition of Nigerians because their edible seeds provide cheap alternative source of dietary protein (Ofuya, 2001; Ofuya and Adedire, 2004; Adedire et al., 2011; Ileke and Olotuah, 2012). Their seeds are veritable sources of minerals (such as calcium, iron), vitamins, fat, thiamine and riboflavin (Nelson, 1991) and serve as sources of protein to people who cannot afford animal protein derivable from fish, meat, milk and eggs (Egho, 2010; Augustine, 2011). The major food legumes cultivated in Nigeria are Cowpeas (*Vigna unguiculata* (L.) Walp), Pigeon pea (*Cajanus cajan* (L.) Mills), Mung bean (*Vigna radiata* (L.) Wukezek), African yam bean (*Sphenostylis stenocarpa* Hochst) and Green gram (*Vigna mung* (L.) Hepper). Cowpea, one of the several species of the widely cultivated genus Vigna, is an annual legume crop and one of the most important food legume crops in the semi-arid tropics (Singh et al., 2003). A drought tolerant and warm weather crop, cowpeas are well adapted to the drier regions of the tropics, where other food legumes do not perform well. It has the ability to fix atmospheric nitrogen through its root nodules and it grows well in poor soils with more than 85% sand and less than 0.2% organic matter and low levels of phosphorus (Singh et al., 2003). Apart from being an important source of food for humans, this crop is also used as feed for livestock.

Callosobruchus maculatus is major pest of cowpea that affects yield, integrity of tissue component and developmental stage of the plant. A female adult can lay

over a hundred eggs, and most of them will hatch. Eggs are laid on the surface of a bean, and when the larva emerges about 4 to 8 days later it burrows into the bean (Raina, 1970). During development, the larva feeds on the interior of the bean, eating the tissue under the surface. It leaves a very thin layer through which it exits when matured thereby producing emergent holes. Effects of seed feeding beetles included low yield in cowpea due to damages such as weight loss and seeds riddled with exit holes (Olatunde et al., 1991; Egho, 2011; Diouf, 2011; Adebayo et al., 2013). This has made production of cowpea difficult and unprofitable. Adebayo and Idoko (2012) opined that cowpea seeds damaged by *C. maculatus* are quantitatively and qualitatively reduced as grain and seeds for humans but could be included in compounding animal feeds. There were reductions in the radicle and plumule emergence, growth and yield parameters of infested cowpea seeds when the position of the emergent holes was considered (Anonymous, 2012). Therefore, the objective of the study is to evaluate the effects of number of emergent holes on the performance of holed cowpea seeds.

MATERIALS AND METHODS

Study area

The study was carried out at the Pest Management laboratory and the screen house of the Department of Crop, Soil and Pest Management, Federal University of Technology, Akure, Ondo State, Nigeria.

Experimental procedures

Infested cowpea seeds holed by *C. maculatus* were sorted into seeds lots bearing no hole, 1, 2, 3 and 4 emergent hole(s). The experiment was conducted as a Completely Randomized Design with three replications. Seeds were sown into 5 L plastic buckets filled with sandy loam soil. Five seeds were sown circularly in the buckets and later thinned to three seedlings after emergence. Each bucket was watered twice a week to field capacity. Five days after emergence, data were collected on number of seedlings with which percentage emergence was calculated. Number of leaves, plant height, plant girth and number of branches were measured forthnightly (2, 4, 6 and 8 weeks after sowing). At harvest, data were collected on the number of pods, number of seeds per pod, length of pod and weight of seeds per pod.

Data analysis

Prior to the analysis, data taking by counting were square root transformed while the data calculated to percentage were arcsine transformed. Transformed data were subjected to analysis of variance (ANOVA) using SPSS version 17. Means were separated with Tukey's HSD test at 5% level of significance and results presented in Tables.

RESULTS

Percentage emergence was significantly different among seeds with different number of emergent holes. Significantly highest percentage (86.70%) was recorded with seeds bearing a hole while lowest percentage (20.00%) was recorded with seeds bearing four emergent holes. However, there was no significant difference ($p>0.05$) among seeds having two, three or zero (control) emergent holes (Table 1).

Results on the number of leaves and plant height of seedlings produced with varying numbers of emergent holes are presented in Table 2. At two weeks after sowing, significantly highest number of leaves (1.99) was recorded on seeds without hole while significant lowest number of leaves (1.14) obtained on seeds bearing four emergent holes. However, there was no significant difference ($p>0.05$) among seeds having 2 and 3 emergent holes and the control. At the 8th weeks after planting lowest number of leaves (1.48) was obtained on seeds with four holes and was significantly different ($p<0.05$) from others. The plant height increased steadily with the number of weeks after planting. The plant height at 8th weeks after planting was significantly highest (107.00) in seeds with one hole and was significantly lowest (11.50) in the seeds containing four emergent holes.

Plant girth and number of branches from the seeds having varying number of emergent holes were different statistically ($p<0.05$). Plant girth increased with weeks after planting. Highest plant girth was recorded in the control, seed with one and two holes but was least in the seeds bearing four holes. Number of branches were highest in the control and seeds with one hole while it was least in the seeds with four holes but were not significantly different ($p<0.05$) from each other (Table 3).

There were no significant differences ($p>0.05$) on mean number of pods among the seeds bearing different number of emergent holes at 6 and 8 weeks after planting (Table 4). Significant highest number of pods (1.52) was recorded on seeds bearing an emergent hole and was significantly higher ($p<0.05$) than the mean value of pods (1.14) obtained on seeds bearing three and four emergent holes (1.17).

There was no significant difference ($p>0.05$) among the mean number of pods and pod length at 10th week after planting. Significant highest number of pods (1.99) was recorded on seeds with two emergent holes while lowest (1.33) was obtained on seeds with three (3) and four (4) emergent holes (Table 5). Significantly higher pod length (13.90) was recorded on seeds with 3 emergent holes while lowest pod length (12.60) was recorded on seeds with 4 emergent holes. Total number of seeds and weight of seeds per pods were significantly different ($p<0.05$).

Table 1. Percentage emergence of cowpea seeds bearing different number of emergent holes.

Treatments	Percentage emergence (%)
Control	60.00[ab]
One hole	86.70a
Two holes	60.00[ab]
Three holes	46.70[ab]
Four holes	20.00[b]

Means bearing the same alphabet(s) along the column are not significantly different using Tukey's test at 5% level of significance.

Table 2. The effects of number of emergent holes on the number of leaves and plant height of cowpea seeds at 2, 4, 6 and 8 weeks after planting.

Treatments	No of leaves per Weeks				Plant height (cm) per weeks			
	2	4	6	8	2	4	6	8
Control	2.89[ab]	1.99[a]	3.25[a]	3.36[a]	10.20[a]	62.90[a]	92.87[a]	94.60[a]
One hole	1.87[a]	3.50[a]	3.60[a]	3.41[a]	14.70[a]	48.87[a]	59.93[a]	107.00[a]
Two holes	1.80[a]	3.21[a]	3.38[a]	3.38[a]	27.77[a]	56.83[a]	62.50[a]	68.77[ab]
Three holes	1.69[ab]	3.76[ab]	2.52[ab]	2.52[ab]	22.70[a]	36.53[a]	41.60[a]	43.47[ab]
Four holes	1.14[b]	1.46[b]	1.48[b]	1.48[b]	1.67[b]	1.67[b]	10.43[b]	11.50[b]

Means bearing the same alphabet(s) along the column are not significantly different using Tukey's test at 5% level of significance.

Table 3. The effects of number of emergent holes on the plant girth and number of branches of cowpea at 2, 4, 6 and 8 weeks after planting.

Treatments	Plant girth in cm per weeks				Number of branches per weeks			
	2	4	6	8	2	4	6	8
Control	3.33[b]	4.13[a]	4.23[a]	4.47[a]	1.14[a]	1.58[ab]	1.61[a]	1.61[a]
One hole	3.63[ab]	4.37[a]	4.73[a]	5.63[a]	1.65[a]	1.89[a]	1.65[a]	1.65[a]
Two holes	3.13[b]	3.97[a]	4.43[a]	5.07[a]	1.52[a]	1.59[ab]	1.52[a]	1.52[a]
Three holes	5.07[a]	2.80[a]	3.53[a]	4.03[a]	1.43[a]	1.31[ab]	1.42[a]	1.42[a]
Four holes	0.40[c]	0.53[b]	0.67[b]	0.80[b]	1.34[a]	1.14[b]	1.17[a]	1.17[a]

Means bearing the same alphabet(s) along the column are not significantly different using Tukey's test at 5% level of significance.

Table 4. Effects of the number of emergent holes on the mean number of pods at 6 and 8 weeks after planting.

Treatments	No of pods	
	Week 6	Week 8
Control	1.15[a]	1.47[a]
One hole	1.29[a]	1.52[a]
Two holes	1.18[a]	1.44[a]
Three holes	1.34[a]	1.14[a]
Four holes	1.17[a]	1.17[a]

Means bearing the same alphabet(s) along the column are not significantly different using Tukey's test at 5% level of significance.

Table 5. Effects of number of emergent holes on mean number of pods, pod length, number of seeds and mean weight of seeds at ten (10) weeks after planting.

Treatments	Mean no of pods	Pod length (cm)	Total no of seeds	Mean weight of seeds(g)
Control	1.91[a]	12.70[a]	2.64[a]	3.67[a]
One hole	1.88[a]	10.87[a]	2.89[a]	4.00[a]
Two holes	1.99[a]	13.63[a]	3.05[a]	4.00[a]
Three holes	1.33[a]	13.90[a]	1.72[b]	2.00[ab]
Four holes	1.33[a]	12.60[a]	1.72[b]	1.67[b]

Means bearing the same alphabet(s) along the column are not significantly different using Tukey's test at 5% level of significance.

Seeds with 2 emergent holes have significant highest number (3.05) of seeds per pods while the lowest number of seeds per pods (1.72) was obtained in seeds with 3 and 4 emergent holes.

The weight of the seeds was significantly higher (4.00) in the seeds with 1 and 2 emergent holes and was lowest (1.67) in seeds with 4 emergent holes (Table 5).

DISCUSSION

This study shows that heavily infested cowpea seeds with many emergent holes have low percentage germinability and this agrees with the earlier reports by Ofuya and Agele (1990) and Ofuya (2003) who concluded that damage to the seeds of cowpea by the bruchids beetles negatively affect the germinability of the seeds and caused reduction in weight. Observation from the study also shows that there were reductions in some of the parameters such as number of leaves and number of branches during growth and development due to the emergent holes created by *C. maculatus* on the seeds. This confirms the report that infestation by the cowpea seed beetle can result in a significant reduction in germination and yield of cowpea (Ofuya, 2003; Adebayo et al., 2013). The study also showed that cowpea seeds infested with *C. maculatus* were affected at stages of growth. This might be due to reduction in size of the endosperm occasioned by the feeding activity of larvae. Effects of seed feeding beetles were reported to cause low yield in cowpea as a result of the damage caused such as weight loss and seeds riddled with exit holes (Olatunde et al., 1991; Egho, 2010; Diouf, 2011; Adebayo et al., 2013). This has made production of cowpea difficult and unprofitable. Adebayo and Idoko (2012) in a study opined that seeds damaged through infestation by *C. maculatus* though were both quantitatively and qualitatively affected as grain and seeds, suggested that the damaged seeds should be utilized as inclusion in animal feeds. There has been report of reduction in the radicle and plumule emergence, growth and yield parameters of infested cowpea seeds when the position of the emergent holes was considered (Anonymous, 2012). The vigor of the holed cowpea seed was affected at earlier stage of growth and subsequently affected the number of leaves, girth and number of branches; this could also be as a result of damage and reduction to the endosperm of the holed seeds. At the later stage of development of the holed seeds, there seems to be a compensatory effect which improved the performance of the heavily holed (3 and 4 holes) seeds. In this study, mean weight of seeds and number of seeds in pod were lower in plants produced from 3 and 4 emergent holed seeds. This is probably why floatation method is used to determine seeds that are suitable for sowing since light weight seeds might result in poor germination, reduced vigor and yield.

Conclusion

Based on the results obtained, it was concluded that emergent holes in infested cowpea seeds have effects on the growth performance of cowpea at the early growing stage of cowpea. This consequently caused significant effect on the yield parameters when the seeds were severally holed. Seeds with two emergent holes compared favorably with those without holes while seeds bearing four emergent holes were negatively affected in their measured growth and yield parameters. It was therefore, recommended that seeds of cowpea that are unfit for consumption (3 or 4 emergent holed cowpea seeds) should be utilized as planting material instead of total discard.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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