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Full Length Research Paper

Effects of application of phosphorus fertilizer on brown blotch disease of cowpea

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A field experiment was conducted to investigate the effects of level of phosphorus application on brown blotch disease of cowpea during the planting seasons of 2001, 2002 and 2003. Application of phosphorus from Single Super Phosphate at 30, 60, 90, and 120 kg P_2O_5/ha significantly increased the number of petioles, pods, nodules, seed/pod leaf area and yield. The higher the level of application of phosphorus the higher values of all the parameters. Disease incidence and severity of brown blotch were significantly reduced at higher levels of phosphorus (90 and 120 kg/ha) irrespective of the method of application. Moreover, there were also increases in the grain yield of cowpea

Key words: Cowpea, disease phosphorus, levels, methods.

INTRODUCTION

Cowpea (*Vigna unguiculata* [L.] Walp) is an important grain legume in drier regions and marginal areas of the tropics and subtropics. It is particularly important in West Africa with over 9.3 million tonnes annual production (Ortiz, 1998**).** The grains are good source of human protein, while the haulms are valuable source of livestock protein (Fatokun, 2002) . Cowpea disease constitutes one of the most important constraints to profitable cowpea production in all agro ecological zones where it is cultivated. Among the fungal diseases, brown blotch is the most devastating with yield loss of about 46% in Northern Nigeria (Alabi, 1994), but could reach 75% in wet years in the same area (Emechebe and Shoyinka, 1985) . In the forest ecological zones the yield loss could be as high as 85% (Shoyinka, 1981).

Phosphorus fertilizer application has been observed to reduce rice blast disease. Repeated application of phosphorus fertilizers delays the onset and lessens the severity of take-all disease of barley just as potassium application reduces the disease incidence in many cases probably by increasing phenolics synthesis in plants. Calcium application also reduces bean root rot caused by *Rhizoctonia solani* probably by altering pectin metabolism of the host (Tawari, 2002)

Phosphorus, although not required in large quantities is critical to cowpea yield because of its multiple effects on nutrition and nitrogen fixation (Muleba and Ezumah, 1985). It also influences the contents of other nutrients in cowpea leaves Kang and Nangju, 1983) and seed (Omueti and Oyenuga, 1970) . Agboola and Obigbesan (1977) reported that P uptake by plant was highest with the use of Single Super Phosphate (SSP). Therefore, the present study was carried out to study the effect of level and method of application of phosphorus on cowpea yield parameters and brown blotch disease.

MATERIALS AND METHODS

Field operation

Brown blotch infected seeds of Ife brown variety of cowpea popular among the farmers in the south west Nigeria were collected from the seed store of the Institute of Agricultural and Training, Ibadan. The studies consisted of a field experiments and were conducted during the growing seasons of year 2001, 2002 and 2003 at the Institute of Agricultural and Training, Ibadan. The site is located at Latitude 7^{o}31 N and longitude 3^{o}45 E and 210 m above sea level in the forest -savanna transition agro-ecological zone of Nigeria. The field was laid out in a randomized complete block design. The treatments consisted of four levels phosphorus (0; 30, 60, 90, and 120 kg P_2 O_5/ha) and two methods of application (basal placement and foliar spray). Three years before the experiment started, the plot had been cropped continuously to maize with no fertilizer. The

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Table 2. ANOVA table of the influence of levels and method of phosphorus application on yield components and brown blotch disease of Ife Brown variety of cowpea.

Sources	df	Petioles/ Plant 10^2	Pod/ Plant 10^2	Nodule/ Plant 10^2	Seed/pod	100-seed wt (g)	Leaf area (cm^2)	Disease incidence 10^2	Disease severity	Yield Kg/ha
Treatment	8	2.33**	7.18**	13.77**	29.43**	3.86*	68.92*	18.16**	1.78**	47.98**
Rep	2	0.19	3.71	0.86	1.93	0.05	6.90	20.14**	2.70*	37.2*
Env*Rep	4	0.01	0.05	2.75	1.45	1.47	3.49	0.36	0.32	6.20
Env*Trt	16	0.13	1.13	5.96*	4.33	1.39	17.70	0.25	0.29	18.71
Error	48	0.30	0.70	2.33	2.78	0.89	15.43	1.52	0.66	16.48

*Significant at 5% level of probability.
** Significant at 1% level of probability.

Table 1. Mean values of analyzed physicochemical properties of the soil of the experimental site at Ibadan, Nigeria in years 2001, 2002 and 2003.

Soil characteristics	0-15 cm soil depth
Percentage clay	5.2
Percentage silt	9.8
Percentage sand	85.0
Soil Texture	Sand loam
pH (H_20)	5.5
Organic carbon	0.063
Total nitrogen (%)	0.07
Available phosphorus (ppm)	0.87
CEC (meq/100g soil)	3.39
Exchangeable bases (meq/100g soil)	
Ca^{2+}	2.04
Mg^{2+}	0.50
K^{+}	0.14
Na^{+}	0.35

physicochemical properties of the experimental field were analyzed before cultivation for the three years (Table 1). The land was ploughed and harrowed twice. There were 27 square plots of 25.00 m^2 each, with 1 m paths across the rows and along the rows (nine treatments replicated thrice). The seeds were planted on the 4^{th} September in each year. Four seeds were planted per hole at a spacing of 75 X 30 cm which were thinned a fortnight later to two plants. The basal placement of the fertilizer was done at planting on the side of the cowpea hill and foliar application was done four weeks after planting. Weeds were adequately controlled with the mix of Gramozone (paraquat) and Galex 500E (metolachor + metobromuron) as pre-emergent herbicides at 2.5 l/ha with two hoe weeding at three and six weeks after planting (WAP). Of the seven rows of cowpea per plot, four core rows containing between 121 and 140 plants were involved in data collection. The crop was protected from insect pests with the use of Nuvacron (metabromuron and metolachlor) at 100 ml in 10 L of water.

Growth and yield parameters such as number of petioles were counted and leaf areas measured at 50% podding, while the numbers of pods, nodules, seed/pod 100-seed weight and yield kg/ha were assessed at maturi**ty.** Disease incidence was calculated from the number of infected plants in the plant population. The severity of brown blotch disease on individual pod on each plant was determined using the following visual assessment scale:

0- No symptoms
1- Up to 20% pods part covered with brown blotch
2- 21-40% pods part covered with brown blotch
3- 41-60% pods part covered with brown blotch
4- 61-80% pods part covered with brown blotch
5- Over 80% pods part covered with brown blotch

Statistical analysis

The data collected from different treatments were statistically analyzed using the Statistical Analysis Software at 5% probability and means separated using the Duncan New Multiple Range Test .

RESULTS

Soil test (Table 1) before the experiment indicated that the soil used in this study was very low in available P (0.87 ppm) as determined by the procedure described by Laverty (1961). Table 2 show the analysis of variance of the effect of the different levels and method of application of P on yield parameters and brown blotch disease of cowpea. The results show that significant differences occurred among the treatments irrespective of the parameters ($P<0.05$). The influence of the environment was significant only on the number of nodules per plant (Figure 1). The number of petioles per plant (Figure 2) as well as the number of pod per plant (Figure 3) was not significantly different among the three growing seasons irrespective of the level and method of application. However, the environment significant influence the number of nodules when plants were sprayed with 30 kg/ha and 120 kg/ha with both application methods.

There were also no significant variations in the effect of the phosphorus fertilizer among the three growing

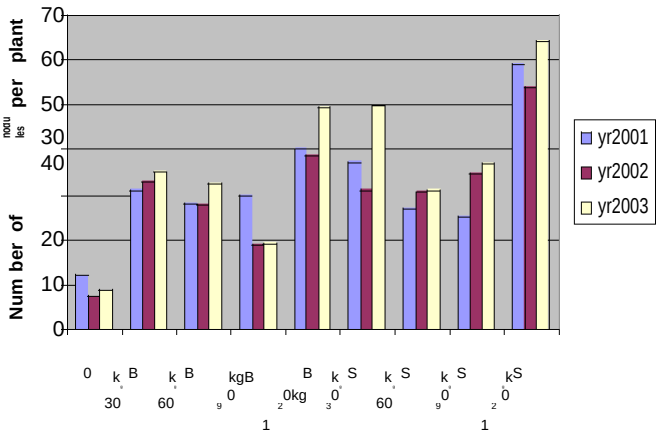

Figure 1. Effect of levels of phosphorus and method of application on the number of Ife brown cowpea nodules.

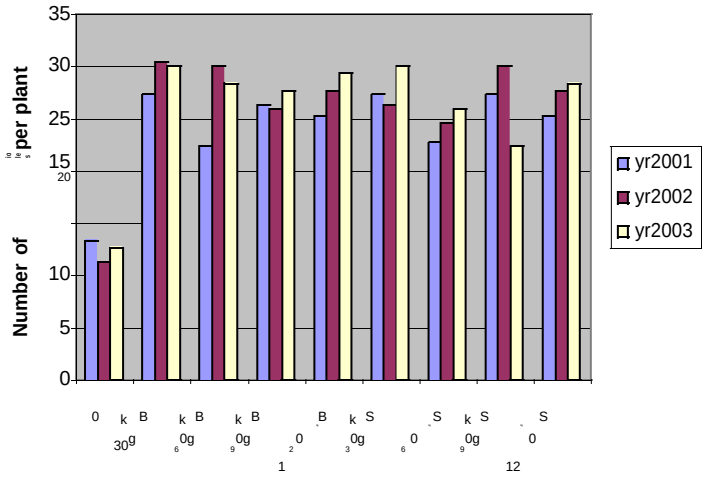

Figure 2. Effect of levels of phosphorus and method of application on the number of Ife brown cowpea petioles.

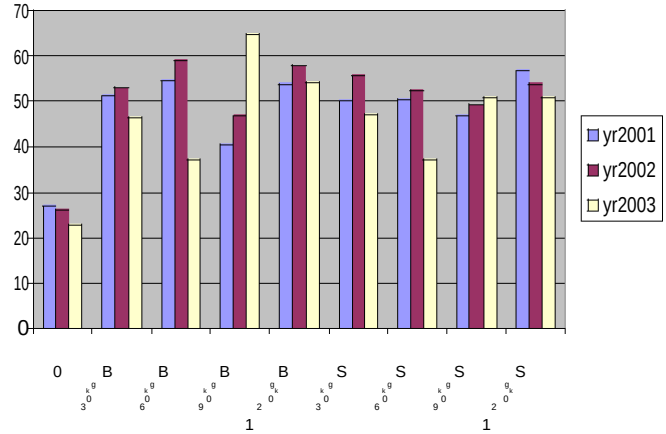

Figure 3. Effect of levels of phosphorus and method of application on the number of Ife brown cowpea pods.

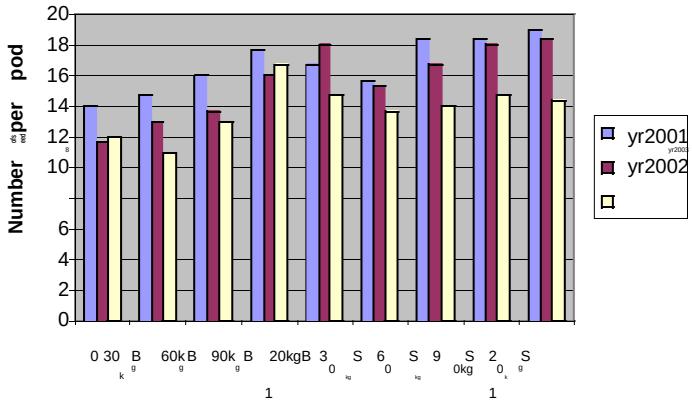

Figure 4. Effect of levels of phosphorus and method of application on the number of Ife brown cowpea seeds.

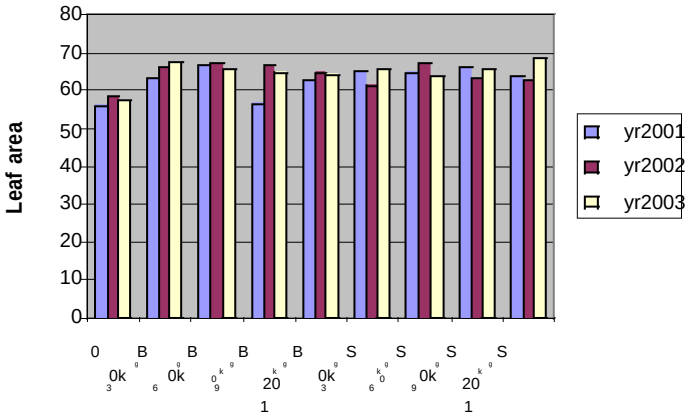

Figure 5. Effect of levels of phosphorus and method of application on the number of Ife brown cowpea leaf area.

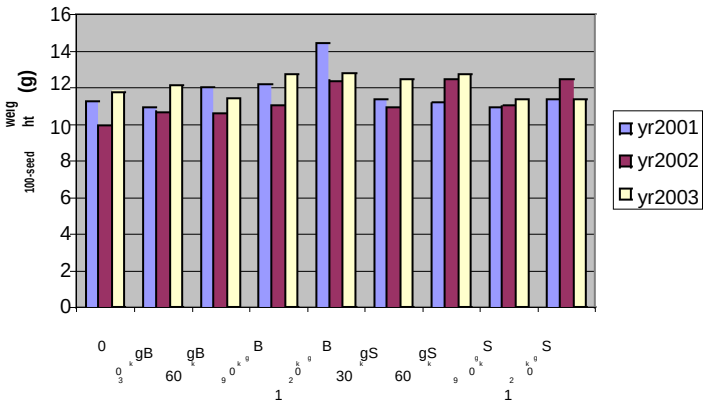

Figure 6. Effect of levels of phosphorus and method of application on the number of Ife brown cowpea 100-seed weight.

seasons on the number of seeds per pod (Figure 4), leaf area (cm^3) (Figure 5), 100 -seed weight (Figure 6), and yield kg/ha (Figure 7). The efficacy of the different levels and methods of application of P in reducing brown blotch

Table 3. ANOVA table of the influence of levels and methods of phosphorus application on yield components and brown blotch disease of Ife Brown variety of cowpea.

Application methods	Phosphorus Level (Kg/ha)	Petioles/ Plant	Pod/ Plant	Nodule/ Plant	Seed/ pod	100-seed wt (g)	Leaf area (cm^2)	Disease incidence	Disease severity	Yield (Kg/ha)
Broadcasting	30	29.22[a]	50.23d	25.89d	12.82d	102.3b	20.56[a]	66.33b	3.50b	993.85b
	60	24.78[a]	60.32c	36.00c	14.23bc	103.9b	24.11[a]	26.11de	2.78b	1454.58a
	90	26.67[a]	69.67a	42.67b	16.78a	128.4a	26.33[a]	24.89de	1.00c	1450.96a
	120	27.44[a]	75.12a	46.78a	16.88a	129.9a	27.67[a]	21.67cd	1.00c	1482.11a
Foliage Spray	30	27.89[a]	50.87d	26.33d	15.22b	105.4b	23.89[a]	48.00c	2.00c	983.07b
	60	24.44[a]	58.22b	39.55c	15.34b	120.8a	26.88[a]	30.33e	2.00c	1431.96a
	90	26.56[a]	69.00a	42.21b	17.12a	130.5a	26.77[a]	29.11d	1.00b	1462.50a
	120	32.66[a]	73.78a	47.56a	17.22a	137.1a	26.78[a]	25.44de	1.00b	1498.08a
control		12.44[b]	25.22e	19.44e	12.56d	85.5c	18.88[b]	80.11a	4.2a	647.74c

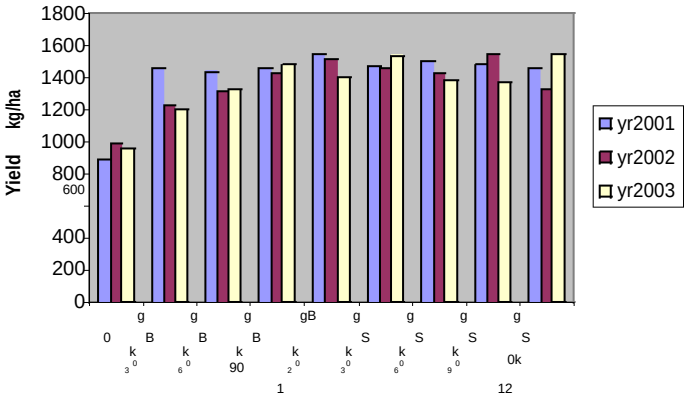

Figure 7. Effect of levels of phosphorus and method of application on the yield of Ife brown cowpea in year 2001, 2002 and 2003.

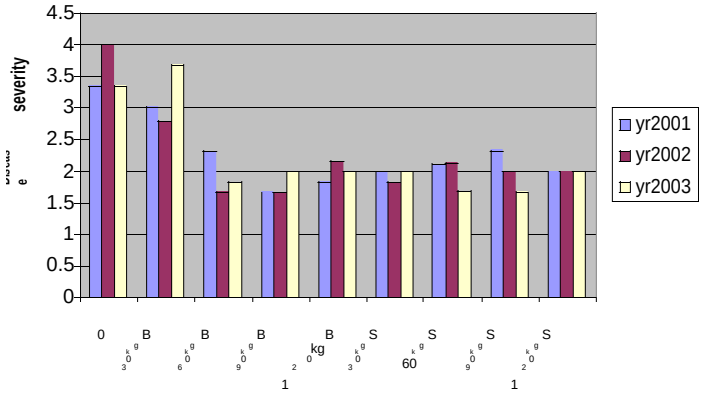

Figure 9. Effect of levels of phosphorus and method of application on the severity of brown blotch disease of cowpea.

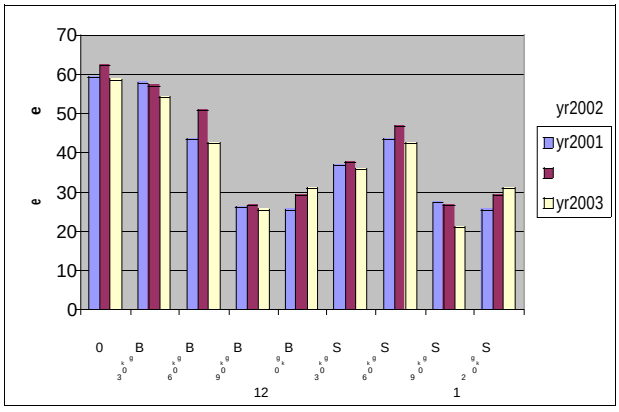

Figure 8. Effect of levels of phosphorus and method of application on the incidence of brown blotch disease of cowpea.

disease incidence (Figure 8) and severity (Figure 9) among the three growing seasons were not significantly different. The results in Table 3 show that significant differences did not occur among the levels P irrespective of the method of application on the number of petioles. However, the number of petioles in these treatments was significantly higher than in the control. The maximum number of petioles (32.66) was recorded when the plant was sprayed with 120 kg/ha of P. Application of higher doses of P significantly increased the number of pods/plants and nodules/plant irrespective of method of application.

The highest number of pods (75.12) was obtained when the crop received 120 kg/ha of P fertilizer applied basally while the maximum number of nodules of 47.56 was recorded when the same quantity of P was sprayed on cowpea. Application of higher doses P increased the leaf area compared to the control but all the treatment were statistically at par with each other. The number of seeds per pod increase significantly with increase in the levels of P fertilizer. There were however, no significant differences in the number of seed per pod between the

control and basal application of 30 kg/ha of P. Foliar spray of P at 120 ka/ha gave the highest number of seed per pod (17.22) while the control experiment gave the lowest seed/pod of 12.56. The data in Table 3 revealed a significant increase in 100-seed weight with increase in the concentration of P irrespective of method of application. However, foliar application of 120 kg/ha of P gave the maximum 100- seed weight (137.10 g) while the control gave the lowest 100-seed weight of 85.5 g. The results indicated that all the fertilizer treatments gave significantly higher yield as compared to control. Table 3 also showed that P application significantly increased the grain yield of Ife-Brown cowpea variety compared with the recommended 30 kg/ha and the control. However, among the fertilizer treatments, foliar application of 120 kg/ha of P produced the highest grain yield (1493.07 kg/ha). The results in Table 3 also show that application of P at 90 kg/ha and 120 kg/ha irrespective of method of application reduced the incidence and severity of brown blotch disease significantly. The highest disease incidence and severity were observed with control.

DISCUSSION

The significant response of cowpea variety to P application in terms of growth parameters, grain yield and reduction in the incidence and severity of brown blotch disease is an indication that P is an important nutrient element influencing the performance of cowpea plant on the field. Tenebe et al. (1995), Ankomah et al. (1996) as well as Okeleye and Okelana (1997) observed significant increase in nodulation, grain yield, total dry matter, numbers of flower, pods and seed per plant for cowpea varieties in response to P application. The increase in nodulation observed in this study contradicts the findings of Kolawole et al. (2002) who reported a decrease in number of nodules due to increase in P application, but agrees with the results of Luse et al. (1975), Agboola and Obisesan (1977) and Ankomah et al. (1996). The observed increase in cowpea grain yield due to increase in level of P in this study is in consonance with the results reported by Tenebe et al. (1995), Ankomah et al. (1996) and Kolawole et al. (2002), but disagrees with the results obtained by Agboola and Obigbesan (1977) and Osiname (1978) who did not observe significant effect of on the yield of cowpea with increased levels of P at Ibadan, but rather enhanced nodulation and P content of leaf and stem.

The results of this study also show that application of P significantly reduced the incidence and severity of brown blotch disease of cowpea. The response of Ife-Brown variety of cowpea to this disease could be as a result of enhanced root growth and development, consequently improved nutrient uptake for vigorous vegetative growth that could have resulted in disease escape. The results agree with the report of Tenebe et al. (1995) that increase in height and vegetative growth of cowpea lines occurs with an increase in P application. We also observed that significant differences did not occur between the two application methods except for the fact that 120 kg/ha P applied by foliar spray gave the highest yield. However, it was observed that cowpea plants that received foliar spray of P had their leaves more greener (dark green) and healthier those with basal application Moreover, the time and amount of energy expended on foliar application is less than in application. Thus, foliar application of 120 kg/ha of phosphorus from SSP ensures the high yield and reduction in incidence and severity brown blotch disease of Ife-Brown variety of cowpea, but 60 kg/ha of phosphorus basal application gave an optimal yield of the cowpea variety.

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