

Full Length Research Paper

A study of the effects of Apron plus 50DS and soil amendment on the growth, yield and food components of soybean

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Comparative effects of Apron plus 50DS (a systemic fungicide) and soil amendment (poultry droppings) on growth yield and food components of soybean (TGX 1485-1D) were studied. Soybean seeds treated with recommended dose of Apron plus 50DS had lower percentage germination when compared to the other treatments while the untreated seeds (control) had the highest percentage germination. Seeds treated with Apron plus and planted on amended soil gave the best performance in terms of development and yield. Biochemical analysis of harvested seeds showed an increase in protein content of seeds treated with recommended dose of Apron plus, planted on amended soil. Seeds treated with less than the recommended dose had the highest percentage carbohydrate content, while untreated seeds planted on amended soil had the lowest carbohydrate content. The control experiment had the highest percentage crude fibre while the lowest was recorded for seeds treated with recommended dose of Apron plus, planted on amended soil. However, there is no significant difference among the treatments in percentage ash and moisture content.

Key words: Apron plus 50DS, soil amendment, soybean, yield.

INTRODUCTION

Soybean (*Glycine max* (L.) Merrill) is a commercial crop of many developed and developing countries of the world. The crop is an important oil seed grown as a food crop (Wolf and Cowman, 1975), and is presently world's most important oil seed in terms of total production and international trade. Soybean is mainly cultivated for its seed, used commercially as human food, livestock feed and for extraction of oil (Mehetre et al., 1998). The Nigerian livestock industry has in recent years started incorporating soybean meal as source of essential amino acids because of its high protein content. Soybean is

affected by numerous pests and pathogens such as insects, nematodes, vertebrate pests, fungal, bacterial and viruses diseases which, either singly or in combination, are responsible for the sub-optimal yields recorded and the deterioration in the quality of the seeds in storage (Oyekan and Naik, 1987). The rapid growing demand by industries in recent years for soybean seeds and its wide spread utilization for both human and animal dietary needs are indication of the great awareness for its nutritive value (Uwala et al., 1998). This sudden change has in turn generated considerable demand for the commodity. This high demand has led to increased soybean cultivation by farmers. However, there is a concomitant increase in pests and diseases problems associated with increased cultivation. It has been reported that virtually all the growth stages of soybean from seedling emergence in the tropics are under severe pests

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and diseases attack (Sinclair and Backman, 1989; Thottappilly and Rossel, 1987). Major insect pests of soybean include Green stink bug (GSB) – *Nezara viridula*, pod sucking bugs, Golden wing moth, *Aphis glycines*, *Maruca testulalis* (Ezuch and Dina, 1980; Jackai et al., 1985). Soybean fungal diseases include Frog eye leaf spot, soybean rust, charcoal rot, seed decay and brown spot (Akem, 1996). Fungicides and insecticides have been used to control these pests and diseases. The fungicides in general use are benomyl, carboxin and carbendaxin (Mcewen and Stephensen, 1979). Prior to the production of systemic fungicides, most fungicides functioned as protectants unable to enter plant tissue in sufficient quantity to affect fungal growth significantly. A number of new compounds are now available. These compounds move systematically in plants to hinder fungal growth, offering new opportunities in plant disease control. One of such systemic fungicide is Apron plus (100 g/kg metalaxyl, 60 g/kg carboxin and 340 g/kg furathiocarb).

Although references to indirect or secondary effects of pesticides are many in literatures, few studies have been undertaken for the specific purpose of determining the effect of pesticide on growth, yield and food component of soybean. Also the effect of fungicide planted on amended soils had not been thoroughly investigated. The objectives of this study were to investigate the efficacy of recommended and below recommended doses of Apron plus in controlling field diseases of soybean; determine the effect of this fungicide on growth, yield and food component of soybean; investigate the effect of soil amendment (poultry droppings) on the efficacy of recommended dose of Apron plus in controlling field diseases of soybean; and compare the effect of the fungicide on soybean plants planted on both amended and unamended soils.

MATERIALS AND METHODS

Seeds of TGX 1485-1D were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, while Apron plus 50DS was obtained from Ibadan office of Ceiba- Geigy Swiss Nigerian Chemical Company Limited. Fifty pots of 21 cm diameter and 19.5 cm depth were filled with unsterilized soil collected from behind glass-house of Institute of Agricultural Research and Training (I.A.R. and T.), Moor Plantation, Ibadan, while the poultry droppings were obtained from Bora Farm of Federal College of Animal Health and Production Technology, I.A.R. and T., Moor Plantation, Ibadan. The unsterilized soil was used to mimic field condition. The pots were set-up on the floor of glass-house using a completely randomized design. 250 g of poultry droppings were thoroughly mixed with twenty pots, and the pots were watered daily for seven days before sowing the soybean seeds. This was to enable the droppings to decompose in the soil.

Twenty-five grammes of TGX 1485-1D soybean seeds was weighed into five sterile polythene bags in the Plant Protection Laboratory of Institute of Agricultural Research and Training (I.A.R. and T.), Moor Plantation, Ibadan. Apron plus 50DS was applied at the recommended rate of 10 g to 2 kg of soybean seeds.

Hence for 25 g seeds, 0.125 g of Apron plus 50DS was applied;

while 0.0625 g of Apron plus 50DS was used for the sub-dose. The basis for under dosage was to check if this could also give effective protection as the recommended dose. Each of the polythene bags was labeled to identify the treatment to be planted as follows:

- A. 25 g of soybean seeds dressed with 0.125 g Apron plus 50DS planted on unsterilized soil.
- B. 25 g of soybean seeds planted on amended soil (poultry droppings + soil).
- C. 25 g of soybean seeds dressed with 0.0625 g Apron plus 50DS planted on unsterilized soil.
- D. 25 g of soybean seeds dressed with 0.125 g Apron plus 50DS planted on amended soil (poultry droppings + soil).
- E. 25 g of undressed soybean seeds planted on unsterilized soil (control).

The planting was done on 23rd September, 2002 and each treatment was replicated ten times. Three seeds were planted per pot and were later thinned down to one healthy seedling per pot after one week on the 5th day. The pots were watered every other day. Weeding was carried out two weeks after planting and at every other day until harvesting. Flowering commenced thirty days after planting and podding on the 40th day after planting. Harvesting began on the 16th December and the experiment was terminated on 23rd December, 2002.

Weekly data collection started fourteen days after planting (14 DAP) and continued until harvesting. The plants were observed for disease expression and pest infestation. Data were taken on the following growth parameters: plant height, number of leaves, time of flowering, number of flowers, number of pods per plant, percentage filled pods, number of empty pods, number of seeds/pod, weight of pods/plant and weight of seeds/plant. Lastly, proximate analysis was carried out to assess the effect of the five treatments on the nutritional status or food component of the harvested seeds. Harvested seeds were analysed for percentage protein, fat, fibre, ash and moisture content. Results obtained from the growth and yield parameters as well as the proximate analysis were subjected to analysis of variance while the various treatments were compared using DMRT. The weights of pods and seed were compared using LSD at ($P < 0.05$).

RESULTS

Germination and growth

Germination was observed to occur three days after planting in treatments B, C and E while it occurred fourth day after planting in treatments A and D. Treatments B, C and E had the highest percentage germination of 90%, followed by treatment D with 80% while the least was observed on Treatment A with 70% (Table 1). Throughout the duration of the experiment, the soybean plants were observed to be relatively free from diseases in all the treatments. There was no marked difference in plant height among the treatments, however, treatment A had the highest plant height at 45 DAP while treatment E (control) had the lowest plant height. The effect of the various treatments on plant height was observed not to be significantly different when subjected to analysis of variance. Treatment D had the highest mean number of leaves/plant while treatment E had the lowest but the difference was not significant. Soybean plants treated with recommended dose of Apron plus 50DS were

Table 1. Effect of treatments on growth and yield components of soybean (TGX 1485-1D).

Treatment	% Germination	Mean plant height (cm)	Mean no. of leaves	Mean no. of flower	Mean no. of pods	Mean wt. of pods/plant	Mean wt. of seeds/plant
A. Soybean + 0.125 g Apron plus + unsterilized soil.	70	34.75 ± 0.13 ^a	91.00 ± 0.21 ^c	47.0 ± 0.40 ^c	8.0 ± 0.10 ^a	60.0 ± 0.41 ^a	30.2 ± 0.04 ^a
B. Soybean + amended soil	90	31.50 ± 0.21 ^a	87.50 ± 0.05 ^b	40.0 ± 0.10 ^a	36.0 ± 0.21 ^a	52.8 ± 0.32 ^a	34.4 ± 0.03 ^a
C. Soybean + Sub-dose on unsterilized soil.	90	32.00 ± 0.20 ^a	79.33 ± 0.05 ^a	34.20 ± 0.86 ^d	32.0 ± 0.11 ^a	58.2 ± 0.28 ^a	33.2 ± 0.11 ^a
D. Soybean + 0.125 g on amended soil.	80	31.80 ± 0.17 ^a	102.60 ± 0.18 ^d	52.32 ± 0.14 ^d	42.0 ± 0.16 ^a	56.4 ± 0.21 ^a	44.8 ± 0.08 ^a
E. Soybean + unsterilized soil control.	90	30.33 ± 0.14 ^a	75.00 ± 0.17 ^a	38.02 ± 0.13 ^a	30.0 ± 0.20 ^a	34.8 ± 0.24 ^a	26.4 ± 0.10 ^a

Means followed by the same letters are not significantly different according to LSD (P < 0.05).

Table 2. Effect of treatment on food component of harvested soybean seeds.

Treatment	% Moisture content	% Protein	% Carbohydrate	% Crude fibre	% Fat Content	% Ash content
A. Soybean + 0.125 g Apron plus + unsterilized soil.	6.6289 ^a	37.5717 ^d	27.5700 ^d	5.0080 ^d	17.9164 ^d	5.3050 ^a
B. Soybean + amended soil	6.8202 ^a	***37.0100 ^c	21.2128 ^e	4.0700 ^d	22.4099 ^b	5.2052 ^a
C. Soybean + Sub-dose on unsterilized soil.	6.7067 ^a	**37.0140 ^c	28.7303 ^a	4.9517 ^c	17.3150 ^e	5.2823 ^a
D. Soybean + 0.125 g on amended soil.	6.8420 ^a	****41.5717 ^a	22.1321 ^c	4.0100 ^e	20.2102 ^c	5.2340 ^a
E. Soybean + unsterilized soil control.	6.7625 ^a	*30.2819 ^d	21.9393 ^d	5.7750 ^a	22.4882 ^a	5.7250 ^a

Means followed by the same letters are not significantly different according to LSD (P < 0.05).

observed to commence flowering earlier than the other treatment (31 DAP). The flowering peak occurred at 38 DAP with treatment D having the highest number of flowers and treatment C with the lowest. Treatment D had the highest mean number of pods at 66 DAP while treatment E had the lowest mean number of pods. Treatment A had the highest pod weight/plant while treatment E had the lowest. There is no significant difference among the treatments in the mean weight of pods/plant and in the number of seeds/pod. Treatment D had the highest mean weight of seeds/plant while treatment E had the lowest mean weight of seed/plant, although there is no significant difference among the treatments.

Biochemical analysis

Table 2 shows the effects of the various treatments on the different food components of harvested seeds. There is no significant difference among the treatments in

percentage moisture and ash contents. Significant differences however occurred in proteins, carbohydrates, crude fibre and fat contents. Treatment D had the highest percentage protein while treatment E had the lowest. Treatment C had the highest percentage carbohydrate while treatment B had the lowest. Treatment E had the highest percentage crude fibre while treatment D had the lowest. Treatment E had the highest percentage fat content while treatment C had the lowest.

DISCUSSION

Generally, soybean plants were observed to be relatively free from diseases in this experiment. This could be attributed to the fact that healthy seeds were used and planting operation was performed off-season when disease incidence was very low. Seeds of soybean dressed with recommended dose of Apron plus 50DS i.e. treatments A and D were found to germinate slowly than

those of other treatments. This could be attributed to the fact that, Apron-plus 50DS being a mixture of insecticide and fungicide, like most systemic fungicides when applied as seed dressing have been reported to be phytotoxic and delays germination (N.A.S. 1971). According to Delp (1987), delayed emergence was observed when a massive dose of benzimidazole was applied on seeds and soil. Seeds treated with sub-dose of Apron plus 50DS (Treatment C) and the control experiment (Treatment E) had high percentage germination. The high percentage of germination recorded for seeds planted on amended soil can be attributed to the fact that application of manure brings about an improvement in soil structure, water holding capacity and aeration of the soil (Thavelle, 1988). These combined factors bring about an increased germination of the seeds. Plants from seeds treated with recommended dose of Apron plus 50DS appeared taller than other plants. This observation is in agreement with the work of Von-Scheling and Kulka (1987) in which they found out that when potato seeds were sprayed with 125 ppm suspension of carboxin, there was an increase in plant growth and yield as compared to control. Soybean seeds dressed with recommended dose of Apron plus 50DS and planted on amended soil were observed to have a faster rate of development. This is probably due to the fact that manure used increased the soil fertility thereby increasing the plant vigour and ability of the plant to take-up water and mineral salts from the soil and hence increased photosynthesis and growth. Few replicates of the plants from seeds dressed with sub-dose of Apron-plus 50DS were observed to produce four leaflets on each node instead of three. This could be attributed to the growth stimulating effect of the carboxin in Apron plus though at reduced rate. An increase in yield parameters in terms of number of pods/plant and number of seeds/pod was recorded for seeds treated with recommended dose of Apron plus 50DS as compared to the other treatments. Treatment D had the highest mean weight of seeds/plant in this study. This is in agreement with the report of Oelhalf (1978) which states that organic manure brings about an increased accumulation of assimilates for seed formation. Control plants were observed to have the lowest pod weight per plant although a higher seed weight per plant than seeds treated with sub-dose of Apron- plus 50DS. This is probably due to the fact that Apron plus 50DS expanded the plant vigour to pod formation rather than pod filling as evidenced by quantity of pods produced.

The treatments were observed to have an effect on the protein, carbohydrate, fat and ash contents of the harvested seeds. This result is similar to that reported by Akinlade (1986). Seeds planted on amended soil (both treated and untreated seeds) were observed to have the highest percentage of protein and fat content. This may be attributed to the high percentage of nitrogen, a major constituent of protein in animal manure. The carbohydra-

te content of harvested seeds of seeds dressed with sub-dose of Apron plus 50DS was observed to be higher than those treated with recommended dose. Bonde and Covell (1995) recorded a similar result when copper oxide was used on potato. Seeds harvested from recommended dose of Apron plus 50DS had a lower fat content than the control. Barne (1945) recorded similar result. A decrease in soybean oil content was observed when aero defoliant was applied. However, an increase in fat content of seeds planted on amended soil was observed. This could be as a result of fat-soluble urea present in poultry droppings. The ash content of seeds from all the treatments were observed not to have any significant difference although seeds planted on amended soils appeared to have reduced ash content than the others. The treatments also gave no significant differences in moisture content, although the moisture content of harvested seeds from amended soils was slightly higher than those of other treatments. This could be as a result of the water holding capacity of the amended soils.

In conclusion, the use of the recommended dose of Apron plus 50DS as a seed dressing agent in soybean production was found to stimulate the vegetative growth of the plant. Seeds treated with recommended dose of Apron plus 50DS and planted on amended soil performed better in terms of yield and food quality. The combined effect of the pesticide and organic manure has been found to have a more beneficial effect on soybean production than single effects of each treatment. These combined effects have also been found to produce better yields than the control in all aspects.

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