EFFECTS OF DIFFERENT RATES OF NPK FERTILIZERS ON YIELD AND STORAGE PROPERTIES OF WHITE YAM

E.E. Umanah*

SUMMARY

Experiments were carried out for three years, 1968 to 1970, to determine the most effective rates of application of N P K on the tuber yields of white yam and to assess the effect of the fertilizers on the storage properties of the tubers. Nitrogen application gave higher yield than no nitrogen; 33.6 kg N per hectare was significantly better than no nitrogen (P = 0.05) for 1969 and 1970 seasons. However, no significant increase in yield was obtained by increasing nitrogen from 33.6 kg N per hectare to 67.3 kg N per hectare. Phosphate application depressed yield throughout, though not significantly. Effect of potash application on yield was inconsistent; a nonsignificant yield increase in the first year and depression in the last two years were obtained. Fertilizer applications had no significant effect on weight losses in storage.

RESUME

Des essais ont été menés pendant trois ans, de 1968 à 1970, pour déterminer les taux les plus satisfaisants d'application de NPK sur le rendement en tubercules d'igname blanche et pour évaluer l'effet des engrais sur les propriétés de conservation des tubercules. Le rendement lorsqu'on applique l'azote a été plus élevé que celui obtenu sans recours à l'azote (P = 0.05) pendant les saisons 1969 et 1970. Toutefois on n'a pas noté d'augmentation sensible lorsqu'on a accru l'azote de 36.6 kg à 1'hectare à 67.3 kg à 1'hectare. Le phosphate a un effet dépressif sur le rendement, mais à un moindre degré seulement. L'effet de 1'application de la potasse sur le rendement est resté très léger; il n'y a pas eu d'accroissement sensible pendant al première année, ne de dépression pendant les deux dernières années. L'effet d'applications de l'engrais sur les pertes de stockage était peu sensible.

RESUMEN

Por tres años, de 1968 a 1970, se llevaron a cabo experimentos para determinar las dósis de aplicación más efectivas de NPK, en el rendimiento de tubérculo de ñame blanco y para establecer el efecto de los fertilizantes sobre las propiedades de almacenaje de los tubérculos. Las aplicaciones de nitrógeno produjeron mayor rendimiento que cuando no se aplicó; 33.6 kg N por hectárea fué significativamente mejor que no nitrógeno (P = 0.05) para las temporadas de 1969 y 1970. Sin embargo, no se obtuvo un incremento significativo del rendimiento cuando el nitrógeno se aumentó desde 33.6 kg N por hectárea hasta 67.3 kg N por hectárea. La aplicación de fosfato redujo el rendimiento, si bien que no significativamente. El efecto de las aplicaciones de potasio, sobre el rendimiento, fué inconsistente; se obtuvo un incremento no significativo del rendimiento el primer año y descenso de él, en los dos últimos años. La aplicación de fertilizantes no tuvo un efecto significativo sobre la pérdida de peso durante el almacenamiento.

INTRODUCTION

Several investigators have demonstrated positive response of yams (*Dioscorea* spp) to nitrogen fertilizer. Irving[4] obtained a significant response to nitrogen applied as ammonium sulphate. He obtained no response to phosphorus application, and sometimes its use actually depressed tuber yield. For potassium, there was a general overall response to lower rates of application, but higher rates usually had little further effect. Significant response to K was only obtained on sites that were under permanent rotations. When yams were grown after 'bush fallow' where K was available from the burning of the bush, lower response resulted. Coursey[3] has reviewed most of the literature on yams including fertilizer trials. Sobulo[6] studying nutrient content of yams with age, found an increase in potassium content of the soil after a yam fertilizer trial.

Okafor[5] studied incidence of rotting of yams and concluded that 5.0 to 68.5 percent of the yams rotted in storage. The objectives of this study were to investigate the response of yams to N P K fertilizer and the effect of these fertilizers on the storage qualities of yam tubers.

*Federal Department of Agricultural Research, Ibadan, Nigeria

MATERIALS AND METHODS

The white yam cultivar 'Gwaguzu' which is widely grown in the middle belt of Nigeria was used. Yam setts consisted of either whole yams of 340 g in weight or large yam tubers cut into three parts of top, middle and bottom, each weighing approximately 340 g and randomly selected for each plot. The layout was a 3^3 factorial design, partially confounded and arranged in blocks of 9 units, and replicated three times. Each plot consisted of five one metre ridges, each 7.3 m long, with plants spaced 1.20 m apart on the ridges and with 30 plants per plot. One row of discard was planted around each plot, and one guard row of the same cultivar surrounded the whole trial area. Planting was in the first and second week of March of each year. Fertilizer rates were: N (sulphate of ammonia*) 0, 33.6 and 67.3 kg per hectare, P (single superphosphate*) 0, 22.4, 44.8 kg per hectare and K (sulphate of potash*) 0, 22.4 and 44.8 kg per hectare applied at the middle of May in accordance with the recommendation of Bromfield[2]. Soil analysis was carried out for each plot before and after the experiment. Dry matter and starch contents of tubers were determined at harvest. Some tubers were stored for 5 months on raised platforms, and weighing was done at fortnightly intervals.

RESULTS AND DISCUSSION

Yield and quality of tubers

Positive and significant response to 33.6 kg per hectare N was obtained for 1969 and 1970. The response for 1968 was not significant (Table 1). Response to higher N levels was not significantly superior to this. The first and second order interactions were not significant. When results for the three years were jointly analysed the mean yield for the three years was not significantly different from the control. No significant yield response to P or K was demonstrated. The experiments were carried out in fields of Iwo soil series (1968 and 1969) and Iregun soil series (1970). These soils are very shallow and are still in the process of formation from the sedimentary parent materials.

Phosphorus and potassium status in the soil during tye trials was high; 13.45 to 213.66 kg P per hectare and 35.06 to 214.58 kg K per hectare before and after the experiments. The high levels of these elements in the soil probably accounted for the absence of response when fertilizers were applied. This was confirmed for the three years when no positive response was demonstrated. These results agree with those of Amon and Adetunji[1] in which response to P and K was clearly related to the parent materials from which the soil was formed.

Dry matter and starch contents of tubers as influenced by the elements applied are shown in Table 2. There was no significant difference between treatments. Interactions were not significant. Thus N did not appear to affect the quality of the tubers.

Effect of fertilizer on yam storage

There were no significant losses in weight due to treatment (Table 3). Mean weight losses due to storage was 20 percent of initial weight. This weight loss appeared to be directly proportional to the initial weight of stored tubers. In this experiment care was exercised in selecting for storage only tubers which had received little or no bruising at harvest. The incidence of rotting was therefore negligible.

In the farmers' fields, it is probable that large tubers resulting from fertilizer use receive more bruises at harvest than unfertilized yams, hence a high incidence of rotting in storage is often noticed on them. This observation would proably be supported by the results of Okafor[5] in which up to 68.5 percent of damaged tubers rotted in storage. This experiment did not indicate that the tuber quality was impaired by fertilizer application.

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*Responses obtained with any of these fertilizers may be partially due to S as well as to N, P or K. Ed.

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TABLE 1

Summary of mean yield of tubers in t/ha

A Nitrogen

N kg/ha	1968	1969	1970	Mean
0	17.32	15.86	16.79	16.64
33.6	18.80	17.57*	19.43*	18.60
67.3	18.51	17.87*	21.13*	18.97
Mean	17.95	17.09	19.19	

S.E. of treatment Mean± 1.70 * Significant difference at
CV =13.6% P = 0.05

B Phosphorus

P kg/ha	1968	1969	1970	Mean
0	18.12	18.07	19.57	18.57
22.4	17.39	16.69	17.49	17.19
44.8	18.37	16.56	18.17	17.95
Mean	17.95	17.09	18.39	

S.E. of treatment Mean ± 1.93
CV =12.5%

C Potassium

K kg/ha	1968	1969	1970	Mean
0	17.57	17.69	20.33	18.42
22.4	18.42	16.82	18.52	17.92
44.8	17.90	17.12	18.70	17.89
Mean	17.94	17.09	18.25	

S.E. of treatment Mean ± 1.80
CV =11.4%

TABLE 2

Effect of fertilizer treatments on dry matter and starch contents of tubers

Treatment kg/ha		Dry matter content (%)	Starch content (%)
N	0	30.4	18.9
N1	33.6	33.0	19.6
N1	67.2	32.8	17.4
P0	0	31.5	18.9
P1	22.4	32.3	19.3
P1	44.8	32.5	17.9
K0	0	32.2	19.1
K1	22.4	31.9	17.4
K1	44.8	32.1	19.2

S.E. of treatment Mean ± 1.82 ± 1.64
C.V. = 13.3% ± 10.4

TABLE 3

Effect of fertilizer treatments on weight loss

Treatment kg/ha		Wt. loss (grams)	
N0		599.6	
N1	33.6	637.8	
N1	67.2	624.8	
P0		600.7	
P1	22.4	617.4	N.S.
P1	44.8	629.9	
K0		595.3	
K1	22.4	632.0	
K1	44.8	624.5	

S.E. of treatment Mean ± 21.26
CV = 17.8%