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COMPLEMENTARY EFFECTS OF POULTRY MANURE AND INORGANIC FERTILIZERS ON THE FIELD PERFORMANCE OF IRRIGATED WHEAT/ POTATO INTERCROP IN JOS PLATEAU, NIGERIA

J. C. OKONKWO and A. C. CHIBUZO

National Root Crops Research Institute
Irish potato Programme, Kuru Plateau State
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ABSTEACT

Studies were carried out in 1995 and 1996 dry seasons to determine the effects of poultry manure and N.P.K. fertilizers on the field performance of irrigated wheat/potato intercrop. The results showed that ½ dose of poultry manure (3.2 tonnes/ha) + ½ dose of N.P.K. fertilizers (60kg N and 60kg $p_2^0 5$/ha + 20kg $k_2 0$/ha) were as good as applying full dose of N.P.K. fertilizers alone for potato/wheat intercrop production. Both sources of nutrient increased tuber and grain yields more than full dose of poultry manure applied alone. Average land equivalent ratio of 1.78 shows a yield advantage of potato/wheat intercrop over wheat or potato planted alone.

INTRODUCTION

With the increasing costs of inorganic fertilizers and decreasing soil productivity as a result of bush burning, intensive cropping without adequate supply of soil nutrients, over-grazing and soil erosion, potato farmers in Jos Plateau, Nigeria are increasingly using organic sources of soil nutrients to replenish soil fertility (Okonkwo et. Al 1995).

During the dry season poultry and cowdung manures are widely used in potato and vegetable crops production. Tisdale and Nelson (1975) and Beukema and Zaag (1979) reported that organic manure not only supplies nutrient to the soil, but also improves the cation exchange and buffer capacities of the soil. They also indicated that organic manure improves the soil structure and texture, and provides energy to soil micro-organisms when it decays. Beukema and Zaag (1979) stated that the organic matter applied for potato production

should not be more than 15 –12 tonnes per hectare.

Studies carried out at Vom, Nigeria to compare the effect of application of 6.4 t/ha and 6.8 t/ha of poultry. and cowdung, respectively, on yield of potato indicated that poultry manure was superior to cowdung as source of nutrient for potato production (Ifenkwe et. al 1986), Okonkwo et. al. (1995) reported that 120kg of N and 120kg of p_2^05/ha + 40kg k_20 were required for optimum yield of potato/wheat intercrop. In sole potato production, Okonkwo and Ifenkwe (1988) found that application of 100kg N and p_2^05/ha + 40kg k20/ha resulted in highest potato tuber yield. This study evaluated the field performance of irrigated potato/wheat intercrop under poultry manure and inorganic sources of soil nutrients.

MATERIALS AND METHODS

Experiments were carried out during the 1995/96 and 1996/97 dry seasons at Kuru, Jos Plateau on a sandy loam soil having pH of 5.8,% organic matter of 1.59, CEC of 25.4 me/100g, total N of 0.08%, available P of 3.83 ppm and exchangeable K of 0.21 me/100g. Wheat varieties used were Sieta Serros and Florence aurore and the planting rate was 100k per hectare (180, 00 plants/ha.). Potato variety used was Nicola and the planting density was 33,333 plants/ha.

The experiment was set up during the month of November each year and harvested in February the following year. Wheat was planted 7 days after potato. Potato was planted on the rest of ridges while wheat was planted in alternate furrows. Wheat was planted in two rows spaced 15cm apart in the alternate furrows. Sole potato and sole wheat were planted to calculate Land Equivalent Ratio (LER). Land equivalent ratio was calculated for each plot as:-

$$LER = \sum_{i=1}^{m} \frac{yi}{yii}$$

where yi is the overall yield of the it component from a unit area of intercrop, yii is the yield of the component grown as a sole crop over the same area (Trenbath, 1976).

The nutrient sources applied were:-

. No fertilizer (control)
. Full dose of poultry manure (6.4t/ha)
3. Full dose of N.P.K. fertilizer (120kg N and 120kg $p2^05$/ha and $40k2^0$/ha); using urea, Single super phosphate and Muriate of Potash as sources of N, P and K respectively.
4. Half dose of N.P.K. + ½ dose of poultry manure.

The poultry manure was nalysed and found to contain .85 of N, 1.5% p_2^05 and 1.9 k_20. he manure and fertilizers were pplied immediately after

planting potato. Plot size was $12m^2$ and experimental design was randomized complete block with 4 replications. Sprinkler irrigation was used and water was applied every three days. Soil sample was collected from the experimental site before soil was ploughed and analysed for nutrient content.

Net returns from the cropping system was also calculated taking into account all the production inputs and revenue from the potato and wheat. Weed control was carried out manually at 4 and 8 weeks after planting potato. Potato tubers were graded and weighed after harvest. Wheat grain yield was adjusted to 12.5% moisture. Effective tillers/$0.5m^2$, Kernel number per head and 1,000 Kernel weight of wheat were determined and recorded.

RESULTS

Tuber Yield and Tuber Number/m^2

The results showed that application of full dose of poultry manure, ½ dose of N.P.K fertilizer + ½ dose of poultry manure, and full dose of N.P.K. fertilizers to potato/wheat intercrop increased tuber yield by 68, 163 and 208%, respectively, over the control (No fertilizer applied). Table1). Similarly, the three nutrient sources significantly increased tuber number/m^2, but the effects of full dose of N.P.K fertilizers and ½ dose of poultry manure + ½ dose of N.P.K fertilizers on tuber yield and tuber number/m^2 were not significant. Wheat variety neither significantly affected potato tuber yield nor tuber number/m^2 (Table 1).

Table 1: Effect of Nutrient Sources and Wheat Variety on;

(a) Upgraded Tuber yield (tonnes/ha)

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	4.0	6.6	11.5	12.4	8.6
Flourence aurore	3.5	6.2	8.5	10.9	7.3
mean	3.8	6.4	10.0	11.7	

LSD (0.05): Wheat variety 1.8; Nutrient Sources 2.5

(b) Tuber Number/m^2

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	23.8	32.1	48.5	51.0	38.8
Flourence aurore	23.8	29.5	40.3	44.5	34.5
mean	23.8	30.8	44.4	47.8	

LSD (0.05): Wheat variety 5.5; Nutrient Sources 7.7

Wheat Grain yield:

Application of full dose of N.P.K fertilizers had the same effect on grain yield as ½ dose of N.P.K. + ½ dose of poultry manure, and each was better than full dose of poultry manure applied alone (Table 2)

There was no significant variety x nutrient source interaction on grain yield. Sieta serros and Flourence aurore were similarly affected by the nutrient sources. Varietal differences on grain yield was not significant (P = 0.05.

Table 2: Effect of Nutrient Sources and Wheat Variety on:

(a) Wheat Grain Yield (t/ha)

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	0.94	1.52	2.50	2.2.62	1.85
Flourence aurore	1.09	1.81	1.70	2.49	1.77
mean	1.02	1.56	2.10	2.56	

LSD (0.05): Wheat variety 0.40; Nutrient Sources 0.60.

(b) Number of Effective Tillers/0.5m^2

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	168	195	195	274	208
Flourence aurore	163	181	184	160	172
mean	165.5	188.0	189.5	217.0	

LSD (0.05): Wheat variety 36.9; Nutrient Sources 52.2

Wheat Yield Components

Number of effective tillers (tillers with wheat heads and Kernels) was not significantly (p = 0.05) affected by nutrient sources, but there was an increasing trend in tiller number in the order: No fertilizer full dose of poultry manure ½ dose of poultry manure + ½ dose N.P.K fertilizer full dose of N.P.K. fertilizers (Table 2).

Variety x nutrient interaction on tiller number/0.05m^2 was not significant. Application of full dose of N.P.K, ½ dose of poultry manure + ½ dose of N.P.K, and full dose of poultry manure significantly increases kernel number/head by 109.5, 86.0 and 43.1%, respectively, over the control (Table 3). Weight of 1000 kernels was increased by full dose of N.P.K and ½ dose of N.P.K + ½

dose of poultry manure over the control, but not by full dose of poultry manure applied alone (Table 3).

Varietal differences on kernel number/head, tillers/0.5m^2 and 1000 kernel weight were not significant (Table 2 and 3).

Table 3: Effect of Nutrient Source and Variety on:
(a) Kernel Number per head

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	12.8	19.1	25.6	28.4	21.5
Flourence aurore	14.5	20.1	25.4	28.9	22.2
mean	13.7	19.6	25.5	28.7	

LSD (0.05): Wheat variety 2.8; Nutrient Sources 4.6

(b) 1000 kernel weight(g)

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	32.0	34.8	36.9	38.4	35.5
Flourence aurore	34.0	36.5	37.9	39.1	36.9
mean	33.0	35.7	37.4	38.8	

LSD (0.05): Wheat variety 1.8; Nutrient Sources 2.8

Land Equivalent Ratio and Net Returns

The land equivalent ratio (LER) is shown on table 4. Average LER in the study was 1.78 with the highest obtained from the application of full dose of N.P.K or ½ dose of N.P.K + ½ dose of poultry manure. Varietal difference was not significant.

Highest net income was obtained from application of full dose of N.P.K, but this was not significantly different from that obtained by applying ½ dose of N.P.K + ½ dose of poultry manure. Use of wheat variety Sieta serros yielded higher net income than Flourence aurore (Table 4).

Table 4: Effect of Nutrient Source and Wheat Variety on:

(a) Land Equivalent Ratio (LER)

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	1.67	1.71	1.89	1.85	1.78
Flourence aurore	1.73	1.74	1.77	1.87	1.78
mean	1.70	1.73	1.84	1.86	

LSD (0.05): Wheat variety N.S; Nutrient Sources 0.10

(b) Net Income (N)

Wheat Variety	No Fertilizer	Full Dose Poultry Manure	½ NPK + ½ Poultry Manure	Full Dose NPK	Means
Sieta serros	14,410	53,800	129,250	142,930	85,095
Flourence aurore	7,135	48,715	83,050	120,235	64,783
mean	10,772	51,257	106,150	131,582	

LSD (0.05): Wheat variety; 12,875; Nutrient Sources 43,157

DISCUSSION

The results indicate that full dose of N.P. K fertilizer was as good as ½ dose of N.P.K + ½ dose of poultry manure in potato/wheat intercrop production and each of the nutrient sources was better than poultry manure applied alone. The result is consistent with that of an earlier study which showed that poultry manure is inferior to N.P.K fertilizer as a source of nutrient in sole potato production (Ifenkwe et. al. 1986). Although the poultry manure used contained a higher N and k_20 levels than the N and k_20 in the inorganic fertilizer, Tisdale and Nelson (1975) and Burton (1966) reported that the N.P.K elements in the organic and inorganic fertilizers may not be equally available to crops. The poultry manure used in the study was from deep litter poultry management system and contains wood shavings. The manure therefore needed to decompose before the elements it contained could be release for plant's use.

The higher response of grain and tuber yields to N.P.K than poultry manure fertilization may be due to the availability differences of the essential elements from the two fertilizer sources.

Average land equivalent ratio in this study was 1.78, indicating a yield advantage of the potato/wheat intercrop (Table 7)

over sole potato or sole wheat. The net returns from potato/wheat intercrop was controlled by the yields of both crops at the prevailing market prices. With an average yield of 7.9 and 1.8 t/ha for potato and wheat, respectively, potato contributed more to the net income (Table 8). Management of potato/wheat intercrop should therefore be aimed at increasing the yield of potato if the emphasis is on increasing profit from the intercrop.

Tillers per plant, kernel number and weight per plant have been reported to be influenced by both genetic and environmental factors (Martin et. al. 1976, Town seed, 1979 and Peaslee et. al. 1971). In this study, wheat grain yield and the yield components responded similarly to the three nutrient sources, but effective tillers/0.5m^2 was not significantly affected, probably due to the wheat planting density used. Tillers per plant have been reported to decrease with increase in planting density (Maiti and Bidinger, 1981). At high plant density, higher fertilizer rate may be required to change tiller number. The yield components of wheat were not significantly affected by the wheat varieties used and this may account for the non-significant effect of wheat variety on the grain yield. This study shows that application of 60kg of N and P_2O_5/ha + 20kg of k_2O/ha plus 3.2 tonnes of poultry manure/ha was as good as 120kg N and P_2O_5/ha + 40kg K_2/ha applied alone for potato and wheat intercrop production.

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