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Integrated input management in groundnut (*Arachis hypogaea*)–wheat (*Triticum aestivum*) cropping system

M.G. DUDHATRA, M.N. VAGHANI, N.A. KACHOT AND K.B. ASODARIA

Department of Agronomy, Gujarat Agricultural University, Junagadh 362 001

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ABSTRACT

A field experiment was conducted during the rainy and winter seasons of 1990–91 to 1996–97 on medium black, calcareous soil (pH 7.8 to 8.0) at Junagadh (Gujarat). The effect of tillage practices on yield and yield attributes of groundnut (*Arachis hypogaea* L.)–wheat (*Triticum aestivum* L. emend. Fiori & Paol.) cropping system was found non-significant. While treatment 100% recommended dose of fertilizer (12.5, 25, 0 N, P,K kg/ha) with crop residue (1.5 tonnes/tonnes + FYM or green manure @ 5 tonnes/ha) along with 30% higher plant density resulted in higher pod and haulm yields of groundnut as well as grain and straw yields of wheat. Normal tillage in the rainy season and reduced tillage in the winter season with incorporation of various inputs enhanced the total uptake of nutrients (N, P and K). Integrated input management increased uptake by crop and soil status. After 6 years of cropping system, the net amount of N and P added to the soil ranged from 244 to 413 kg/ha and 343 to 409 kg/ha respectively. While the depletion of K ranged from 123 to 323 kg/ha. The highest net returns were obtained under reduced tillage in winter and under higher input levels. The highest net returns Rs 31,366/ha with benefit : cost of 2.95 was obtained under reduced tillage. Higher net returns (Rs 31,219/ha) with higher benefit : cost ratio were obtained under integrated nutrient management along with 30% higher plant density treatment.

Key words : Input management, Tillage, Nutrient uptake and balance, Groundnut, Wheat, Cropping system

Groundnut–wheat is the most popular cropping system in Saurashtra region of Gujarat. However, the yield of groundnut is very low due to the constraints like inadequate and imbalance use of fertilizers, insecticides, fungicides and irrigation water, erratic rainfall, use of low-yielding cultivars, prolonged dry spell especially during critical growth stages etc. Information on nutrient requirement, plant density and tillage practices is very limited particularly when the nutrients are supplied partly through organic and inorganic sources. Sustainability of higher yield could be achieved and maintained only through integrated input management. Therefore,

the present experiment with a view to study integrated input management in groundnut wheat crop sequence was conducted.

MATERIALS AND METHODS

The field experiment was conducted during the rainy and winter seasons of 1990–91 to 1996–97 at Cropping Systems Research Centre, Gujarat Agricultural University, Junagadh. The experiment was laid out in split-plot design with 4 replications. The experiment in main plot consisted of 2 treatments of tillage, viz. normal tillage for rainy and winter season crop (T_1) and normal tillage for rainy and reduce tillage for winter crop (T_2). In subplots, 4 input levels, i.e. nutrient (50%)+ crop residues (1.5 tonnes/ha) + FYM (2.5 tonnes/ha) (N_1), nutrient (100%) + FYM or green-manure (GM) @ 5 tonnes/ha (N_2), nutrient (100%) + FYM or green-manure (GM) (@) 5 tonnes/ha+30% higher plant density (N_3) and nutrient (100%) + crop residues (1.5 tonnes/ha) + 30% higher plant density (N_4) were kept to assess the residual effect of these treatments on groundnut–wheat cropping system. The nutrients recommended for groundnut–wheat are 12.5 and 25 kg N and P/ha and 120, 60 and 0 kg N,P and K/ha respectively. Soil of the experimental site was medium black with clayey texture, well drained with moderately slow permeability, with pH 7.8 to 8.0 and calcareous in nature. The soil was medium in available nitrogen, phosphorus and potassium.

RESULTS AND DISCUSSION

Yield and yield attributes

The impact of tillage on the yield and yield attributes of groundnut and wheat was not significant (Table 1). However, the effect of integrated input management had significantly effect on the yields of ground-

Table 1. Effect of treatments on yield attributes yield and economics of groundnut–wheat cropping system (6-year mean data)

Treatment	Groundnut				Wheat				Net realization	Benefit : cost ratio
	Pod yield (kg/ha)	Haulm yield (kg/ha)	1,000-seed weight (g)	Shelling (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	1,000-seed weight (g)	Grains/ ear		
Tillage system										
T_1	704	1,495	707	70.81	3,464	3,712	39.47	34.38	28,489	2.58
T_2	748	1,514	700	70.55	3,468	3,682	39.53	33.95	31,366	2.95
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS		
Input levels										
N_1	712	1,492	693	70.57	2,918	3,166	39.53	33.21	24,745	2.46
N_2	687	1,455	705	70.97	3,479	3,702	39.28	34.88	28,704	2.64
N_3	742	1,520	703	70.46	3,717	3,950	39.74	34.50	31,106	2.70
N_4	764	1,550	713	70.73	3,751	3,971	39.43	34.06	31,219	2.65
CD (P=0.05)	30.96	26.94	NS	NS	137.4	198.2	NS	6.30		

Details of treatments are given in Materials and Methods

nut and wheat. Significantly highest pod (764 kg/ha) and haulm (1,550 kg/ha) yields were recorded with treatment N_4 and it was at par with treatment N_3. The quality characters such as 1,000-seed weight and shelling (%) were found non-significant. Similar results were observed by Mehta *et al.* (1995).

In succeeding wheat crop, the treatment N_4 gave significantly higher grain yield (3,751 kg/ha) which was statistically at par with treatment N_3. The grains/ear were

Table 2. Balance sheet of available nitrogen, phosphorus and potash after 6 years of cropping

Treatment	Initial soil Status (kg/ha)	Amount applied (kg/ha)	Total	Total uptake (kg/ha)	Gross balance	Soil status after 6 years (kg/ha)	Net balance (kg/ha)
Nitrogen							
T_1N_1	317	1,000.20	1,217.20	690.69	626.51	214	412.51
T_1N_2	317	1,000.65	1,317.65	772.53	545.12	211	334.12
T_1N_3	317	1,000.65	1,317.65	856.23	461.42	217	244.42
T_1N_4	317	1,127.70	1,444.70	845.51	599.19	217	382.19
T_2N_1	317	1,000.20	1,317.20	732.66	584.54	212	372.54
T_2N_2	317	1,065.00	1,382.00	826.16	555.84	209	346.84
T_2N_3	317	1,065.00	1,382.00	857.93	524.07	204	320.07
T_2N_4	317	1,127.00	1,444.70	891.38	553.32	217	336.32
Phosphorus							
T_1N_1	45	526.50	571.50	195.81	375.69	30.1	345.59
T_1N_2	45	615.00	660.00	225.81	434.19	31.8	402.39
T_1N_3	45	615.00	660.00	235.61	424.39	33.4	390.99
T_1N_4	45	624.00	669.00	236.10	432.90	31.5	401.40
T_2N_1	45	526.50	571.50	198.10	373.40	30.2	343.20
T_2N_2	45	615.00	660.00	228.70	431.30	31.5	399.80
T_2N_3	45	615.00	660.00	243.00	417.00	31.5	399.80
T_2N_4	45	624.00	669.00	226.43	442.57	34.0	408.57
Potash							
T_1N_1	330	174	504	499.14	4.86	193	–188.14
T_1N_2	330	150	480	567.39	–87.39	203	–290.39
T_1N_3	330	150	480	502.93	–22.93	201	–223.93
T_1N_4	330	249	599	546.05	32.95	209	–176.05
T_2N_1	330	174	504	428.61	75.39	198	–122.61
T_2N_2	330	150	480	503.99	–23.99	201	–224.99
T_2N_3	330	150	480	580.95	–100.95	222	–322.95
T_2N_4	330	249	579	532.1	46.9	227	–180.1

Details of treatments are given under Materials and Methods

found significant, whereas different treatments failed to show significant effect on 1,000-seed weight of wheat. The maximum straw yield (3,971 kg/ha) was recorded with treatment N_4, being statistically at par with treatment N_3. Singh *et al.* (1999) also reported the beneficial effect of integrated input management in groundnut and succeeding wheat crop, which attributing to the addition of crop residue.

The interaction effect of different treatments did not show significant variation on the yield of groundnut and wheat.

Nutrient uptake and balance

The total uptake N, P and K by both the crops varied from 690.7 to 891.3, 195.8 to 243 and 428.6 to 581 kg/ha. Compared to normal tillage, reduced tillage enhanced the uptake of nutrients. This might be because of natural compaction, which improves the root growth and plant anchorage. The highest N uptake was noticed with maximum input levels and reduced tillage. An application of crop residue @ 1.5 tonnes/ha with 30% higher planting density reduced the P and K uptake.

Comparing the influence of various treatments, it was noticed that there was marked improvement in the N uptake as a result of raising the input levels irrespective of tillage practices. However, in case of P and K uptake the response was not so consistent (Binod Kumar *et al.*, 2000).

Comparison of N, P and K status at the time of sowing of the first crop and that found after harvest of wheat (13^{th} crop) indicated a positive balance of nitrogen and phosphorus and negative balance of potassium in the treatments. The net balance indicates the addition or depletion of nutrients from soil reserves. The highest addition of N was observed at low input levels, while P addition was highest at higher input levels. There is depletion in K under all the treatments but it was not consistent.

It may be noted that relatively low magnitude of K deficit was recorded even with the higher dressing of potassium because the K uptake by crops was far exceeds the quantum of fertilizer input. Although the yield was raised with higher dressings. Similar results were reported by Yaduvanshi *et al.* (1984).

Economics of cropping system

The treatment T_2 was found superior and showed Rs 31,366 more net realization/ha and benefit : cost ratio of 2.95 compared to treatment T_1 (Table 1). In case of input levels, treatment N_4 showed higher net realization (Rs 31,219/ha) in groundnut–wheat cropping sequence, but the higher benefit : cost ratio recorded under N_3. This type of results may be owing to higher yield and market price of groundnut. Deshpande and Jadav (1996) also reported groundnut–wheat cropping sequence as the most remunerative system.

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