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Integrated input management in groundnut (*Arachis hypogaea*)–wheat (*Triticum aestivum*) cropping system under draught-prone areas of semi-arid regions

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ABSTRACT

A field experiment was carried out on nutrient's denuded sandy-loam soil under moisture–stress condition, during rainy and winter seasons of 1996–97 and 1997–98. Groundnut (*Arachis hypogaea* L.) – wheat (*Triticum aestivum* L. emend. Fiori & Paol.) cropping system showed that the integrated use of recommended dose of N_{20}, P_{30} and K_{45} + FYM @ 100 q + gypsum @ 300 kg/ha resulted in significantly higher pod yield (9.38 q/ha), followed by N_{20}, P_{30} and K_{45} + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha (9.28 q/ha). The growth and yield-contributing traits of groundnut were consistent to pod's yield. The residue of N_{20}, P_{30} and K_{45} + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha and application of N_{80} + P_{40} to wheat gave higher grain yield of wheat by 46.24 q/ha than other treatments under late-sown condition. The growth and yield-contributing characters noted in wheat were concordant to the grain yield.

Key words : Integrated input management, Groundnut–wheat system, Drought-prone area

The yield of groundnut is very low due to integrated problems, viz. erratic rainfall, incidence of insect, pests and diseases, inefficient use of nutrients, dry spells, low-yielding cultivars and prolonged draught period, especially during flowering, pegging and pod-development stage.

As per report of Wye College, University of London and available constraints collected from the groundnut growers of Uttar Pradesh the succeeding crops declined their yields raised after it. No farmers would like to grow wheat crop on large scale under late-sown condition. The concept of integrated nutrient management for sustaining the soil fertility is also not being followed by most of the farmers, so far resulted decline in fertility status of sandy soils of Uttar Pradesh.

With the view to enhance the productivity of groundnut–wheat cropping system, enrich the soil, conservation of rain water

in-situ and trapping of nutrients in the same field, the present experiment was planned and executed under situation base study.

MATERIALS AND METHODS

The field experiment was conducted for 2 years, during rainy season and winter season of 1996–97 and 1997–98 at Regional Research Station, Mainpuri, Uttar Pradesh. The soil was sandy loam, having pH 8.5, organic carbon 0.45%, total nitrogen 0.04%, available phosphorus 10 kg/ha and available potash 278 kg/ha, indicating low fertility status of experimental soil. The treatments comprised T_1, N_{20} P_{30} K_{45} (20 kg N, 30 kg P_2O_5 and 45 kg K_2O/ha); T_2, $N_{20}P_{30}K_{45}$ + additional dose of NPK in the form of chemicals to meet out the nutrient availability from FYM @ 100 q/ha; T_3, NPK + FYM @ 100 q/ha; T_4, NPK + FYM @ 100 q + gypsum @ 300 kg/ha; T_5, NPK + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 50 kg/ha; T_6, NPK + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha; T_7, NPK + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 75 kg + oak leaf powder @ 75 kg/ha; and T_8, NPK + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha + seed inoculation with *Rhizobium*. The FYM was applied to groundnut before 1 month of its sowing, while NPK, gypsum and *neem* leaf powder were applied at sowing as per treatment. The groundnut kernels were inoculated with *Rhizobium* culture as per recommendation and treatment. 'Kausal' groundnut was planted in rows 30 cm apart using 100 kg kernel/ha in the second fortnight of July and harvested after 113 days in the first fortnight of November, during both the years.

The succeeding crop of 'Sonalika' wheat was planted in rows 30 cm apart, using 125 kg seed/ha on 25 December and harvested after 118 days on 22 April. The wheat raised on residue of natural resources applied to groundnut with N_{80} and P_{40}. The half dose of N and full dose of P were given at wheat sowing and remaining N was top-dressed at tillering stage. The irrigations were given to wheat as and when required. The experiment was carried out in randomized block design with 3 replications.

RESULTS AND DISCUSSION

Growth, yield traits and yield of groundnut

The integrated use of recommended dose of N_{20} P_{30} K_{45} + FYM @ 100 q + gypsum @ 300 kg/ha registered higher pod yield, followed by N_{20} $P_{30}K_{45}$ + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha in comparison to recommended dose of N_{20} P_{30} K_{45}. The use of $N_{20}P_{30}K_{45}$ + additional dose of NPK in the form of chemical to meet out the nutrients availability from 100 q/ha FYM significantly reduced the pod yield as compared to $N_{20}P_{30}K_{45}$ + FYM @ 100 q + gypsum @ 300 kg/ha. Similarly, the combination of higher dose of *neem* leaf powder @ 75 kg + oak leaf powder @ 75 kg/ha gave significantly lowest pod yield during both the years. The application of FYM @ 100 q in association with N_{20} P_{30} K_{45} gave statistically at par yield with $N_{20}P_{30}K_{45}$ + FYM @ 100 q + gypsum @ 300 kg/ha and $N_{20}P_{30}K_{45}$ + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @

100 kg/ha. The growth and yield-contributing characters recorded in groundnut were found to be consistent to the pod yield (Table 1). Mehta *et al.* (1995) also reported the positive response of integrated use of nutrient with organic fertilizer in increasing the pod yield of groundnut under moisture stress and nutrient-deficit condition.

Growth, yield traits and yield of wheat

The residue of N_{20} P_{30} K_{45} + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha applied to preceding

Table 1. Growth, yield-contributing traits and yield of groundnut under integrated nutrient management (mean data of 2 years)

Treatment	Fresh weight of haulm/ plant (g)	Dry weight of haulm/ plant (g)	Pod/ plant	Pods weight/ plant (g)	Kernel weight/ plant (g)	100-kernel weight (g)	Pod yield (q/ha)
T_1	24.88	9.10	13.21	12.66	9.33	25.38	8.44
T_2	24.16	8.55	11.88	11.55	9.27	24.38	8.01
T_3	32.44	11.88	13.66	12.82	10.77	26.32	9.07
T_4	35.88	12.44	13.99	13.21	11.44	28.43	9.38
T_5	24.21	8.65	12.88	12.33	9.27	24.77	8.22
T_6	33.16	12.32	13.66	12.99	11.21	27.16	9.28
T_7	23.82	8.21	11.44	11.16	8.77	23.99	7.80
T_8	25.21	10.55	13.66	12.66	9.33	25.94	8.97

Details of treatments are given under Materials and Methods

Table 2. Yield traits and yield of wheat under different residue treatments of groundnut (pooled data 2 years)

Treatment	Main shoot height (cm)	Spikes/ plant	Spiklets/ spike	Grains/ spike	Grain weight/ spike (g)	Grain weight/ plant (g)	1,000-grain weight (g)	Yield (q/ha)
T_1	90.53	6.44	15.11	34.88	1.88	8.66	54.66	45.10
T_2	87.73	6.55	14.77	34.66	1.88	8.88	54.33	45.16
T_3	88.00	6.55	15.21	34.22	2.00	8.77	54.66	45.27
T_4	91.06	6.55	15.10	35.33	1.99	8.88	55.66	45.26
T_5	86.06	6.66	15.11	34.22	1.99	9.00	54.00	45.08
T_6	85.40	6.77	15.33	35.11	2.00	9.10	55.66	46.24
T_7	88.40	6.44	14.88	35.22	1.88	8.88	54.33	45.09
T_8	87.20	6.55	14,88	34.77	1.88	8.89	54.66	45.00
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Details of treatments are given under Materials and Methods

crop of groundnut and application of N_{80} P_{40} to wheat gave numerically higher yield of wheat over all other treatments; the yield values of other treatments were statistically at par.

The minimum height was measured with residue of $N_{20}P_{30}K_{45}$ + FYM @ 100 q+ gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha applied to preceding crop of groundnut and $N_{80}P_{40}$ used in wheat, while the maximum was noted in residue of $N_{20}P_{30}K_{45}$ +FYM @ 100 q + gypsum @ 300 kg/ha used in groundnut during rainy season and N_{80} P_{40} applied to wheat during winter season. The value of height in other treatments was between these 2 limits. The other growth and yield-contributing traits of wheat, viz. spikes/plant, spiklets/spike, grains/spike, grain weight/spike, grain weight/plant and 1,000-grain weight, were concordant to grain yield (Table 2).

The better yield of wheat was harvested owing to integrated nutrients management with organic amendment in the preceding crop of groundnut during rainy season and it also saved NPK @ 40, 20 and 40 kg/ha respectively. The positive response of residue management in wheat along with the use of subnormal dose of N, P and K for sustaining the yield of wheat on denuded soils was also reported by Gill *et al.* (1994) in rice–wheat cropping system.

Impact of groundnut on soil improvement

Groundnut provided better cover, controlled high intensity of rains, protected the soil from erosion, checked the run-off and nutrient losses, stored the soil moisture and developed very fine crumby structure. Therefore, positive effect of groundnut cultivation on degraded land was recorded with groundnut–wheat cropping system.

Therefore, the integration of N_{20} P_{30} K_{45} + FYM @ 100 q + gypsum @ 300 kg + *neem* leaf powder @ 100 kg/ha to groundnut and N_{80} P_{40} to wheat may be suggested to use in groundnut–wheat cropping system on nutrients denuded soil under moisture-stress condition in draught-prone areas for enhancing the total productivity and utilizing the benefit of residue by wheat under groundnut–wheat cropping system.

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