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Efficacy of different combination of chemical fertilizer doses on yield of groundnut in Saurastra region

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Abstract
Groundnut (*Arachis hypogaea* L.) is an exhaustive crop and removes large amount of macro and micronutrient. No single source of element is capable to increase crop yield. Therefore, to study the relative effect of different macro and micro nutrient doses on yield and quality of kharif groundnut were studied in the present investigation. The results of the field experiment revealed that the application of higher rate of potassium without phosphorus and with optimum rate of nitrogen, iron, manganese, zinc and copper recorded maximum pod yield (2726, 2858, 2792 kg ha^{-1}) in the year-1, 2 and pooled as compared to combine application of phosphoruas and potash with nitrogen and micronutrient. While, the application of higher rate of phosphoruas and potash with nitrogen and micronutrient recorded maximum haulm yield (3111, 4521, 3816 kg ha^{-1}) in the year 1, 2 and pooled. The application of higher rate of phosphorus with lower rate of potassium recorded higher shelling percentage and test weight. While highest oil percent was recorded with higher rate of potassium with medium to higher rate of phosphorus.

Keywords: *Arachis hypogaea* L, pod yield, fertilizer dose

Introduction
Groundnut (*Arachis hypogaea* L) designated as "wonder legume" in the sense that after flowering, fertilization and fruit set, the pegs (gynophores) elongate and penetrate in to the soil where the fruit enlarges and matures in soil. Among the various agronomic practices, nutrient management has an important role in maximizing the pod yield of groundnut. Judicial use of fertilizers is necessary for increasing agricultural production. Groundnut is an exhaustive crop and removes large amount of macro and micronutrient. No single source of nutrient is capable at supplying plant nutrients in adequate amount and balanced proportion. Therefore, to maintain soil fertility and to supply plant nutrients in balanced proportion for optimum growth, yield and quality of crop, various amounts of macro and micronutrient requires for higher yield. Therefore, keeping the above facts in background, relative effect of different macro and micro nutrient doses on yield and quality of kharif groundnut were studied in the present investigation.

Materials and Methods
The experiment was laid out in randomize block design with the twelve treatments and four replications for two successive years (2002, and 2003). Data were presented for pooled of two year as well as for individual year for the different parameter studied. The treatments consist of nine levels of PK (Phosphorus and Potash) fertilizes (P_{220} K_{140}, P_{165} K_{140}, P_{110} K_{140}, P_{55} K_{140}, P_{00} K_{140}, P_{220} K_{105}, P_{220} K_{70}, P_{220} K_{35}, P_{220} K_{00}) with 20-50-50-25-10 Kg ha^{-1} of N-Fe-Mn-Zn-Cu respectively, and highest PK rate with 20kg N ha^{-1} were compared with state recommendation (N 12.5, P 25 kg.ha-1) as described below.
The groundnut was harvested at complete maturity stage. The plants of groundnut from ring area were collected first, then plants from net plot area were picked up and the pods were separated from the haulm manually by hand picking. After complete air-drying, the treatment wise pod and haulm yield was converted on hectare basis. Observations of yield attribute were taken for individual representative plant from the net plots of the respective treatments at the time of harvesting. Oil content (%) of kernels was determined by nuclear magnetic resonance (NMR) as per the method suggested by Tiwari *et al*. (1974) [1].

Treatment detail

Treatment No.	Details							
T_1	N_{20}	P_{220}	K_{140}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_2	N_{20}	P_{165}	K_{140}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_3	N_{20}	P_{110}	K_{140}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_4	N_{20}	P_{55}	K_{140}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_5	N_{20}	P_{000}	K_{140}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_6	N_{20}	P_{220}	K_{105}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_7	N_{20}	P_{220}	K_{070}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_8	N_{20}	P_{220}	K_{035}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_9	N_{20}	P_{220}	K_{000}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_{10}	N_{20}	P_{220}	K_{140}	Cu_{00}	Fe_{00}	Mn_{00}	Zn_{00}	(Kg ha^{-1})
T_{11}	$N_{12.5}$	P_{25}	K_{000}	Cu_{10}	Fe_{50}	Mn_{25}	Zn_{25}	(Kg ha^{-1})
T_{12}	N_{25}	P_{50}	K_{000}	Cu_{00}	Fe_{00}	Mn_{00}	Zn_{00}	(Kg ha^{-1})

Results and Discussion

The monsoons during the experimental seasons were normal during both the years. The data pertaining to the effect of different treatment on pod yield of groundnut are presented in Table 1. It is apparent from the data that pod yield was significantly affected by different treatments in experimental years as well as in pooled results. Treatment T_5 involving N_{20} P_{000} K_{140} Cu_{10} Fe_{50} Mn_{25} Zn_{25} Kg ha^{-1} produced significantly highest pod yield (2726, 2856 and 2792 kg ha-1) in both the years as well as in pooled and remained at par with T_1, T_2, T_3, T_6 and T_{10} in first years. The increase in pod yield with treatment T_5 were 37.7 in year-1, 46.0 in year-2 and 41.8 per cent in pooled results over treatment T_{11} (recommended dose of fertilizer), with addition of micro nutrients in that order (Fig. 1). The positive response of crop in terms of pod yield might be due to balanced fertilization i.e. application of macro nutrients along with micro nutrients enhances metabolic activities in plant and assimilate transportation from source to sink (Kanwar, 1973) [2]. These results are in complete agreement with those reported by Agasimani and Hosmani, (1989) [3]; Yadav (1990) [4]; Deshmukh *et al.* (1992) [5]; Venkatararamana and Kiraman (2002) [6].

An appraisal of data for haulm yield (Kg ha^{-1}) revealed that the haulm yield was significantly affected by different treatments in individual year and pooled result (Table 1). Significantly highest haulm yield (Kg ha^{-1}) of 3056, 3003 and 3029 Kg ha^{-1} was observed in both years and pooled results. It remained at par with treatment T_1 and T_6 was at par with T_7. Similar response of groundnut to application of different nutrient have also been reported by Asodaria (1994) [7]; Ghetia (1995) [8] and Kachot (1999) [9].

The mature pods per plant were significantly affected by different treatment in both the years. Significantly highest mature pods per plant with value of 10.8 and 12.05 were observed under treatment T_5 in the year-1, and year-2, respectively (Table. 2). It was statistically at par with the year only. The application of fertilizer with treatment T_5 increased mature pods by 60, and 22.3 per cent over T_{11} (recommended dose of fertilizer) in the year 1 and 2, respectively. While pooled results were not found significant however, maximum mature pods plant^{-1} (11.43) was recorded for the treatment T_5 which was 37.7 per cent higher over the recommended dose of fertilizer- T_{11}. It ranged from 8.30 to 11.43 mature pods plant^{-1}, were significantly affected by different treatments. The total pods plant^{-1}, were significantly affected by different treatments in both the years as well as in pooled. Significantly highest total pods plant^{-1} (11.95, 14.35 and 13.15) were recorded with treatment T_5 and were statistically at par with T_2 in first year only. The treatments T_5 increased the total pods per plant up to 51.3, 22.1 and 33.8 per cent as compared to T_{11} (recommended dose of fertilizer) in the year-1, Year-2 and pooled, respectively. It ranged from 7.90 to 11.95 in year-1, 11.75 to 14.35 in 2 year-2 and 9.83 to 13.15 in pooled results under the different treatments.

Shelling percentage, test weight and oil percentage were non significantly affected by different treatments (Table 3) in individual years as well as in pooled except shelling percentage in pooled. The maximum shelling per cent (79.28, 70.45 and 74.86 per cent) were observed in respective years, but significantly highest shelling per cent (74.86) were observed with T_8. Whereas maximum test weight of 63.20 in year-1, 49.78 in year-2 and 55.63 gm/100 seed in pooled were observed with the treatment T_8, T_2 and T_3, respectively, it ranged from 57.90 to 63.20 in year-1, 43.80 to 49.78 in year-2 and 51.10 to 55.63gm/100 seed in pooled under the different treatments. The maximum oil per cent of 50.25 in year-1, 49.23 in year-2 and 49.48 in pooled were recorded with treatment T_2, T_6 and T_2, respectively, and it ranged from 48.56 to 50.25, 48.23 to 49.23 and 48.46 to 49.48 per cent in the year-1, year-2 and in pooled, respectively, under the different treatments. The results present in Table 3 indicated that shelling percentage, test weight and oil content were not affected significantly due to different treatment (Patel and Patel, 1987 [10]; Asodaria, 1994 [7]; Devi Dayal, *et al.*, 2004 [11] and Devi Dayal, 1997 [12]).

Conclusion

The results of the field experiment revealed that the application of higher rate of potassium without phosphorus and with optimum rate of nitrogen, iron, manganese, zinc and copper recorded maximum pod yield (2726, 2858, 2792 kg ha^{-1}) in the year-1, 2 and pooled as compared to combine application of PK with nitrogen and micronutrient. While the application of higher rate of PK with nitrogen and micronutrient recorded maximum haulm yield (3111, 4521, 3816 kg ha^{-1}) in the year 1, 2 and pooled. Similar trends was observed increase of yield attribute like no. of mature pods per plant, no. of immature pods per plant and total pods per plant. Maximum pod yield target was achieved at T_5. The application of higher rate of phosphorus with lower rate of potassium recorded higher shelling percentage and test weight. While highest oil percent was recorded with higher rate of potassium with medium to higher rate of phosphorus.

Table 1: Effect of different dose of fertilizer on yield of groundnut

Treatments	Pod Yield (Kg ha^{-1})			Halm Yield (Kg ha^{-1})		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
T_1	2596	2522	2559	2951	2905	2928
T_2	2639	2467	2553	2709	2753	2731
T_3	2596	2521	2558	2760	2773	2767
T_4	2205	2113	2209	2865	2861	2863
T_5	2726	2858	2792	2865	2807	2886
T_6	2474	2383	2428	2899	2622	2911
T_7	2309	2236	2273	3056	3003	3029
T_8	2570	2505	2537	2865	2928	2896
T_9	2049	2054	2051	2622	2762	2692
T_{10}	2561	2523	2542	2761	2726	2742
T_{11}	1979	1957	1968	2674	2714	2694
T_{12}	2092	2118	2105	2804	2715	2760
S.Em±	109	82	59	83.8	67	46
C.D. at 5%	315	237	167	241	193	131
C.V. %	11.9	10.0	11.0	11.2	10.8	10.7

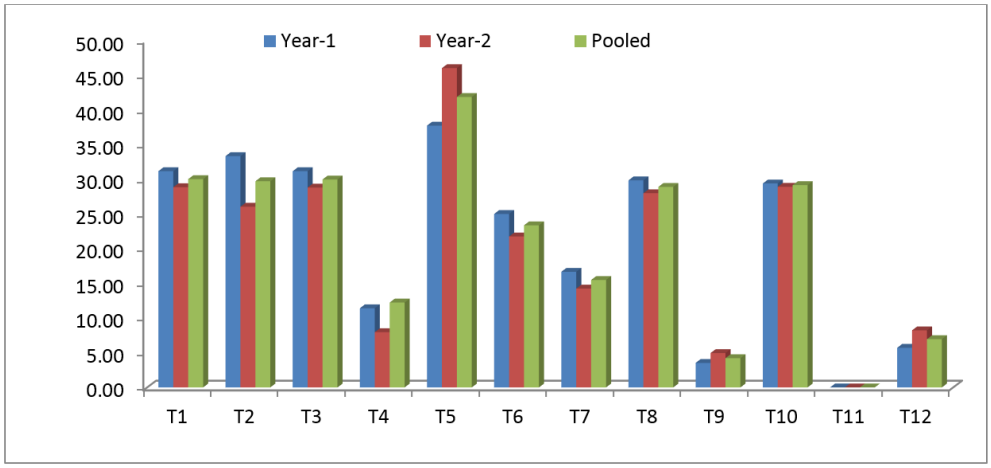

Fig 1: Per cent increase over in pod yield over state recommended dose of fertilizer T_{11}

Table 2: Effect of different dose of fertilizer on number of pods per plant in groundnut.

Treatments	Immature Pod per Plant			Mature Pod per Plant			Total Pod per Plant		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
T_1	1.25	1.95	1.60	9.10	10.25	9.68	10.35	12.20	11.28
T_2	1.10	1.70	1.40	9.80	10.03	9.91	10.90	11.73	11.31
T_3	1.00	2.00	1.50	9.05	10.40	9.73	10.05	12.70	11.23
T_4	1.45	2.00	1.73	7.20	10.45	8.83	8.65	12.45	10.55
T_5	1.15	2.30	1.73	10.80	12.05	11.43	11.95	14.35	13.15
T_6	1.10	2.00	1.55	7.50	10.25	8.88	8.60	12.25	10.43
T_7	1.25	1.80	1.53	7.30	10.40	8.85	8.55	12.20	10.38
T_8	1.10	1.93	1.51	8.75	10.70	9.73	9.85	12.63	11.24
T_9	1.00	1.90	1.45	6.95	10.45	8.70	7.95	12.10	10.03
T_{10}	1.00	1.80	1.40	8.05	10.30	9.18	9.05	12.10	10.58
T_{11}	1.15	1.90	1.53	8.75	9.85	8.30	7.90	11.75	9.83
T_{12}	1.15	1.90	1.53	7.10	10.10	8.60	8.25	12.00	10.13
S.Em+	0.11	0.23	0.11	0.47	0.39	0.52	0.47	0.45	0.50
C.D. at 5%	NS	NS	NS	1.36	1.13	NS	1.36	1.28	1.55
C.V. %	17.2	20.9	20.7	10.0	6.50	8.10	8.80	6.20	7.30

Table 3: Effect of different dose of fertilizer on quality of groundnut.

Treatments	Shelling Per cent (%)			Test Weight (g)			Oil per cent (%)		
	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled	Year-1	Year-2	Pooled
T_1	72.13	69.98	71.05	57.90	48.70	53.30	49.88	48.95	49.41
T_2	72.40	66.78	69.59	60.93	49.78	55.35	50.25	48.70	49.48
T_3	77.88	68.55	73.21	61.58	49.68	55.63	48.69	48.23	48.46
T_4	74.10	69.65	71.88	59.58	46.30	52.94	49.61	48.60	49.16
T_5	74.38	71.23	72.80	69.03	48.83	53.93	49.75	48.90	49.33
T_6	76.58	70.03	73.30	60.53	46.23	53.38	49.33	49.23	49.28
T_7	77.00	70.23	73.61	60.50	48.55	54.53	49.31	48.93	49.12
T_8	79.28	70.45	74.86	63.20	44.78	53.99	48.66	48.70	48.63
T_9	74.35	69.90	72.13	60.48	46.58	53.53	48.75	48.95	48.85
T_{10}	76.03	70.08	73.05	58.28	43.93	51.10	49.50	48.53	49.01
T_{11}	74.10	69.88	71.99	61.10	43.80	52.45	48.56	48.55	48.56
T_{12}	72.93	70.00	71.46	58.10	45.23	51.61	48.69	48.75	48.72
S.Em+	1.87	1.04	0.92	2.00	2.39	1.35	0.50	0.33	0.26
C.D. at 5%	NS	NS	2.61	NS	NS	NS	NS	NS	NS
C.V. %	4.30	2.58	3.61	5.80	8.82	7.13	1.74	1.16	1.48

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