

**EFFECT OF N.P.K. RATIO AND APPLICATION RATE ON SUNFLOWER SEED YIELD AND OTHER CHARACTERISTICS**

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Sunflower (*Helianthus annuus L.*) is a potential new crop in Iran. But there is not enough information available on its nutrition particular to conditions of Iran. Michel ROLLIER (1970) has found that if a hectare of sunflower produces 1 250 kg of seeds, the plants remove 175 kg of nitrogen, 65 kg of phosphorus and 225 kg of  $K_2O$  from soil. While a hectare of wheat with 1 000 kg yield losses 28 kg of nitrogen, 11 kg of phosphoric acid and 24 kg of  $K_2O$  (Selke 1964) these results demonstrate the importance of sunflower fertilization.

Since fertilization is one of the most important factor in increasing crop yield, a study was initiated to determine the effect of NPK-ratios and application rates on seed yield and other characteristics of sunflower.

MATERIALS AND METHODS

This investigation was carried out on a sandy loam soil with pH value 8,3 in plastic pots in a screened chamber. The soil characteristic is shown in table 1.

Table 1

Soil depth cm	pH		CaCO <sub>3</sub> %	Org. matter %	N NH <sub>4</sub> +NO <sub>3</sub> ppm	P available ppm	K available ppm	Ca available mg/100 g soil	Na available mg/100 g soil	Mg available mg/100 g soil	EC mmohs/ cm
	KCl	H <sub>2</sub> O									
0 - 30	7,4	8,3	8,7	0,5	3,5	5,5	300	410	22	65	1,2

The experiment was consisted of 16 treatments with 4 replications. The amount of soil for each experimental unit was 12 kg per pot. The soil for each experimental unit was thoroughly mixed with particular quantities of N P K in forms of Urea, Triple-Super-phosphate and Potassium sulfate. The various treatment combinations are shown in table 2.

Five seeds of sunflower variety record were sown in each pot on April 5, 1971 and the pots were watered regularly to field capacity with tap water which had a pH value of 7,2. After the plants were 5 cm in height, one of the best plant was selected in each pot.

Table 2 - Effects of N.P.K. ratio and application rate on sunflower seed yield and other characteristics.

Treatments			Plant height cm	Diameter of stem cm	Diameter of head cm	Seed yield gr (x)	Fat in %
N	P	K					
0	0	0	72,5	0,70	6,0	0,95	33,6
0	500	0	64,0	0,69	5,9	1,20	-
0	0	500	63,8	0,68	5,8	1,31	35,91
500	0	0	102,3	0,90	11,0	8,97	41,94
0	500	500	65,1	0,53	4,6	1,42	-
500	0	500	98,0	0,86	10,5	8,83	46,99
500	500	0	104,6	1,11	11,5	11,75	49,59
500	500	500	109,8	1,03	11,0	14,21	50,42
500	1 000	500	109,8	0,99	10,8	14,83	49,02
500	500	1 000	111,6	1,01	10,5	12,37	45,72
1 000	500	500	105,6	1,12	11,6	23,48	45,56
1 000	1 000	500	118,3	1,13	13,5	27,56	51,60
500	1 000	1 000	110,0	0,98	11,0	13,05	49,92
1 000	500	1 000	102,5	1,09	11,8	24,08	49,11
1 000	1 000	1 000	108,3	1,15	11,8	25,48	49,58
1 000	2 000	1 000	106,6	1,11	12,0	25,52	50,04

\*) L.S.D. = 3,83

The experiment was conducted under a screened chamber (16 x 5,5 x 2 m).

The screens were of 10 x 10 mm dimensions. The plants were grown under the screen chamber so that to be under natural conditions and also to be protected against birds attack.

#### HARVESTING AND ANALYTICAL PROCEDURES

The plants were harvested on August 5, 1971. Following characteristics were measured : The quantity of seed per plant, plant height from soil surface, head diameter, the diameter of the stem and the oil percentage.

#### RESULTS

The results obtained on the effect of various N P K fertilization on seed yield, plant height, head diameter, stem diameter and oil percentage are presented in Table 2. These results are averages of four replicates. As it is shown in the table 2 phosphorus and potassium fertilization alone with 500 mg per pot without nitrogen did not increase seed yield and other characteristics. These values were almost equal to the control pot. The plants which received 500 mg per pot of nitrogen with no phosphorus and potassium showed increase in seed yield, 9 times, and oil content of 8 % compared to the control pots.

Figure 1 represents graphically the effect of N, P and K separately on plant height, head

diameter and seed yield. If the interaction of the three elements with different combinations are taken under consideration, as shown in Figure 2 phosphorus influences the most when it is applied with nitrogen.

Application of both 500 mg/pot of phosphorus and 500 mg/pot of nitrogen together increased seed yield 12 fold and the oil content 12 % compared with the control. Therefore, the effect of nitrogen on yield and other attributes was more pronounced with phosphorus application. As it is indicated in figure 2, when potassium is used with phosphorus and nitrogen, the highest yield is obtained.

For example 500 mg N : 500 mg P : 500 mg K per pot increased the seed yield 15 times in comparison to control. The oil content did not show any increase but other characteristics of the plants were at optimum compared with other treatments.

When the above N P K ratio was changed to 1 000 : 1 000 : 500 mg per pot there was no increase in growth development of the plants. But the seed yield increased 27 fold compared to the control and the oil content was the most 18 % compare to the control. There was no yield increase - beyond the above ratios of P K applications.

#### DISCUSSION

With consideration of the chemical analysis of the soil in table 1 and the result obtained with N P K application the following recommendations can be given concerning the fertilizer application to sunflower in this soil and similar soils in Iran.

- 1 - The nitrogen, 3,5 ppm and organic matter 0,5 % was too low for a fertile soil therefore the plants responded well to nitrogen fertilization. As the soils in most parts of Iran are deficient in nitrogen and organic matter heavy nitrogen application for sunflower must be recommended.
- 2 - The available phosphorus of the soil was at the level of only 5,5 ppm, which is very low for optimum plant growth and productivity. The high content of  $\text{CaCO}_3$  and alkalinity of the soil reduces availability of phosphorus to the plant. Therefore the plants cannot make optimum use of phosphorus under these conditions without sufficient phosphorus fertilizer application. The results of this experiment clearly shows that maximizing sunflower yield requires heavy application of fertilizer phosphorus in this and similar soil in Iran.
- 3 - The chemical analysis of the soil showed that the available potassium content of this soil was high (300 ppm). But the absorption of this element by plant is hindered by presence of high concentration of other cations like calcium. The calcium content of this soil and most of the other soils in Iran are relatively high which has an antagonistic effect in potassium utilization of the plant. Ehrenberg (1919); Lundegardh (1932), Wetzel (1939) and Alten (1940) have investigated the antagonistic effect of calcium on potassium absorption and they have found that high calcium concentration has a detrimental effect on potassium uptake by plants.

For maximum plant yield there should be a proper balance or ratio between available potassium concentration of the soil and availability of the other major elements. Therefore for better utilization of potassium by plant in this or similar soils one must pay attention to two important factors :

a) High application of nitrogen and phosphorus fertilizers.

b) Moderate application of potassium seems necessary to alleviate antagonistic effect of calcium, as found by Allaway and Pierre (1939). The results of this experiment show clearly that the application of potassium fertilizer in spite of high native potassium concentration of soil showed increase in yield of sunflower.

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Fig. 1 - EFFECTS OF N, P and K ON : PLANT HIGHT, DIAMETER OF HEAD  
AND SEED YIELD OF SUNFLOWER

— = gr. seed yield/Pot  
 - · - · = cm. Plant hight  
 - - - = cm. diameter of head

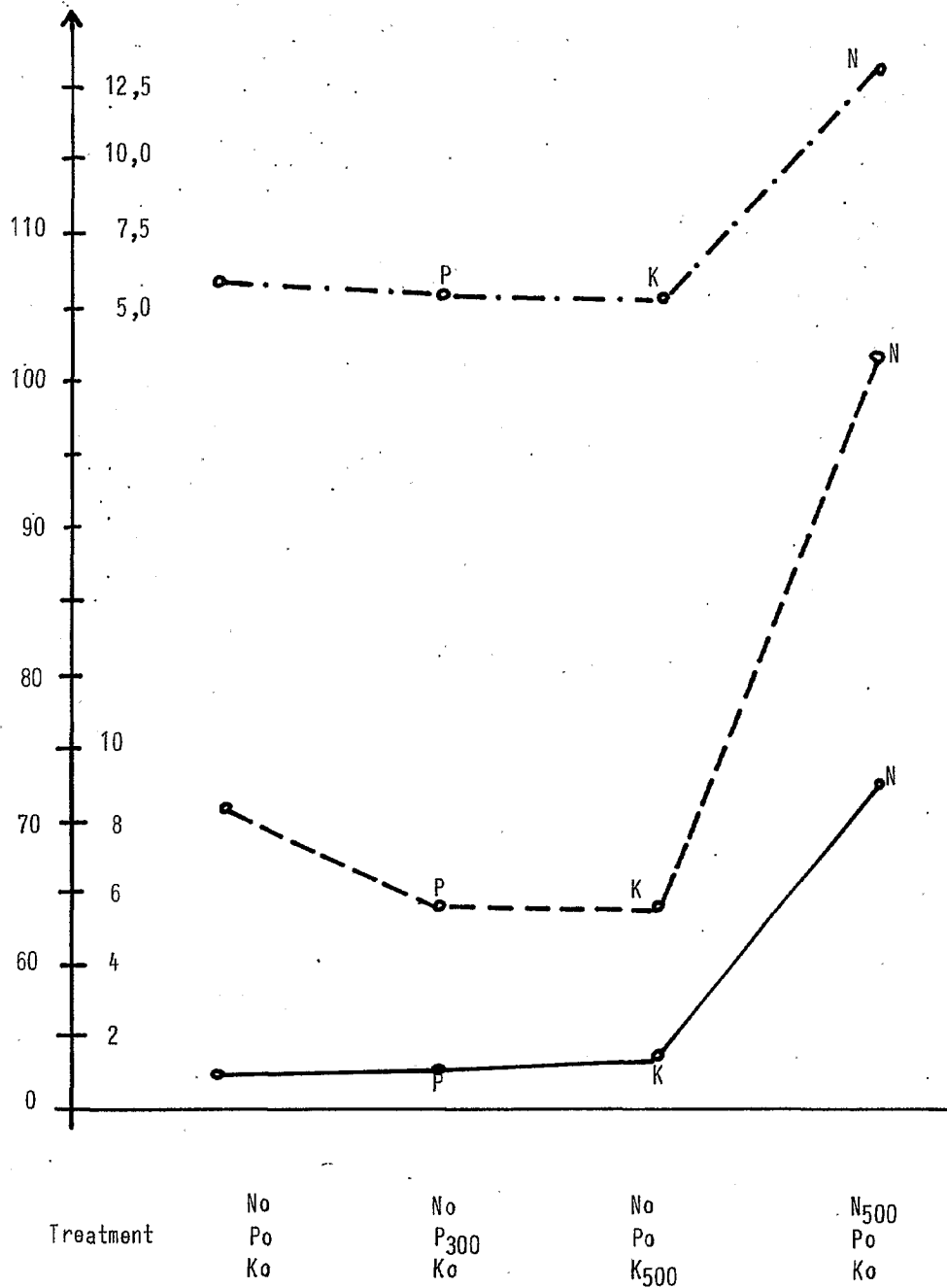


Fig. 2 - EFFECT OF N P K RATIO AND APPLICATION RATE on :  
PLANT HIGHT DIAMETER OF HEAT AND SEED YIELD OF SUNFLOWER

