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EXPERIMENTAL RESULTS CONCERNING THE FERTILIZER APPLICATION IN SUNFLOWER IN ROMANIA

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Sunflower is the main oil-producing plant in Romania.

If the sunflower cultivated surface did not increase very much lately, yet the average per-acre yield was continuously raised (12).

However, taking into account the pedoclimatic conditions favourable to this crop, there are still wide possibilities to increase its yield provided that the agrotechnical rules are always fully observed, together with the recommendations issued on the ground of experimental results (3, 4, 6, 9).

The rational fertilizers application ranges among the efficient steps to be considered in the sunflower crop growing (2, 5, 10, 12).

One of the reasons for the still unsatisfactory sunflower yields is the insufficient fertilizer application, as well as their inadequate ratio. It has been found especially the want of P-fertilizers leading to a luxurious growth of the sunflower plants, to the prejudice of the seed and oil production (2, 7, 9, 11).

The results of the previous scientifical research work, both in our country and abroad, stressed the reduced effect of the organic and inorganic fertilizers upon this crop as against other plants, although sunflower is a big consumer of nutritive elements. This is due mainly to the high capacity of its radicular system to draw nutritive elements from less soluble forms in the soil (1, 2, 6, 8, 9, 11).

Further experiments have been conducted at ICCPT-Fundulea and its experimental network with regard to different aspects of the fertilizer application in this crop; to be more precise, experiments using stable and radioactive isotopes were performed at this research institute.

In order to establish the most efficient fertilizer doses for the various cultivation areas, experiments were carried out at different experimental stations on various types of soil. The obtained results are listed in table 1.

Table 1

Effect of NPK fertilizers on sunflower yield under different soil conditions in Romania

Treatments	Caracal-medium leached chernozem		Mărculeşti-chestnut chernozem		Brăila-chestnut carbonated chernozem		Ileana-chocolate chernozem*		Secuieni-brown chenozem		Oradea-brown podzolic soil*)	
	Average 4 years		Average 5 years		Average 3 years		Average 9 years		Average 5 years		Average 6 years	
	q/ha	diff.	q/ha	diff.	q/ha	diff.	q/ha	diff.	q/ha	diff.	q/ha	diff.
Control	21.7	—	27.2	—	17.1	—	24.2	—	21.6	—	20.0	—
N_{50}	22.1	0.4	28.5	1.3	22.3	5.2	24.8	0.6	23.9	2.3	17.7	—2.3
N_{100}	24.0	2.3	29.0	1.8	22.6	5.3	24.9	0.7	24.4	2.8	14.4	—5.6
P_{50}	22.6	0.9	27.8	0.6	21.1	4.0	25.7	1.4	22.8	1.2	21.8	1.8
P_{100}	23.7	2.0	28.6	1.4	23.0	5.9	26.5	2.4	23.4	1.8	22.6	2.6
$N_{50}P_{50}$**)	23.5	1.8	30.4	3.2	22.1	5.0	27.2	3.0	24.9	3.3	20.7	0.7
$N_{100}P_{100}$	24.3	2.6	31.3	4.1	25.3	8.2	27.8	3.7	26.0	4.4	17.1	—2.9
$N_{100}P_{100}K_{80}$	25.5	3.8	32.9	5.7	26.2	9.1	28.1	3.9	26.1	4.5	20.3	0.3
LSD 5%		2.2		1.3		1.2		1.2		1.2		3.7

*) Rates of P_{35} and P_{70} were used at Ileana and Oradea instead of P_{50} and P_{100}.
**) Rates of P_{35} and P_{70} were used at Secuieni and Oradea

The analyse of the respective data leads to the conclusion that the highest yield gains are obtained on the chestnut carbonated chernozem followed by the chestnut chernozem and the chocolate chernozem soil. The most significant factor — for the yield increase on all these types of soil — is the phosphorus. This element has the greatest influence on the chestnut carbonated chernozem from Brăila and on the chocolate chernozem from Ileana. On the chocolate chernozem from Ileana, the phosphorus applied alone provides certain yield increases while the influence of the nitrogen-alone is insignificant.

Nitrogen has a greater influence at Brăila where it determines yield gains up to 5 q/ha. The joint application of N and P fertilizers on all the types of soil, leads to yield increases proportionally with the respective dose, but with rather small values.

As far as potassium is concerned, a certain tendency for the production increase was noticed as a result of the K-fertilizer application, but only on the medium leached chernozem from Caracal and the chestnut chernozem from Mărculeşti.

The average increases obtained in a 5-year period on the brown-chernozem-like soil from Secuieni were more significant when nitrogen was used, than those obtained with phosphorus, due to the higher P-content of this soil. Thus, the yield increases obtained with N_{50} and N_{100} doses were 2.3 and 2.8 q/ha respectively, as against 1.2 and 1.8 q/ha obtained with the same P-doses. At the joint application of N and P-doses, the highest yield-increase was obtained with a dose of $N_{100}P_{100}$, i.e. 4.4 q/ha.

The inorganic fertilizers proved less efficient on the brown podzolic soil from Oradea.

On this type of soil, the P-fertilizers applied alone brought about little yield increases, while the N-fertilizers caused a certain decrease due to soil acidulation. Under these conditions, even the joint application of both N and P-fertilizers didn't bring about significant yield increases.

A constant increase of the N-fertilizers efficiency is observed when the same quantities of fertilizers are applied on an amendment of 6 t/ha $CaCO_3$.

The alluvial soils from the Danube flood plain react insignificantly to the fertilizer application (table 2). Yield-gains of 2.5 q/ha are obtained on the clay sandy soil. On the silty soil, the high fertility conditions favoured the vigorous growth of the plants, as well as the plants' lodging during the windly showers in the flowering time. The mildew and black spot attacks also caused a decrease in the sunflower yield.

Table 2

Influence of NPK fertilizers on sunflower yield cultivated on alluvial soil in the Danube Delta ; 5-year average

Treatments	Silty soil			Clay sandy soil		
	Yield, q/ha	Difference		Yield, q/ha	Difference	
		q/ha	%		q/ha	%
Control	19.3	—	—	20.5	—	—
N_{50}	18.5	—0.8	—4	23.1	2.6*	13
N_{100}	19.4	0.1	0	22.0	1.5	7
N_{150}	19.4	0.1	0	22.4	1.9	9
P_{50}	19.3	—	0	21.5	1.0	5
$N_{50}P_{50}$	20.0	0.7	4	22.9	2.4	2
$N_{100}P_{50}$	19.4	0.1	0	23.0	2.5*	12
$N_{150}P_{50}$	20.0	0.7	4	22.2	1.7	8
$N_{150}P_{50}K_{40}$	19.7	0.4	2	21.7	1.2	6
LSD 5%		1.4			2.5	

The research works conducted a longer period of time, concerning the influence of the N- and P-fertilizer application upon the sunflower yield, were based on the chocolate chernozem from Ileana-Ilfov. During the period 1959-1967 the N-doses : 0 ; 50 and 100 kg Na.s.//ha were studied as well as their interaction with doses of 0 ; 35 and 70 kg P_2O_5/ha.

The productions ranged — excepting 1962 — between 20—35 q/ha (table 3). The dynamics of the 9 experimental years shows a general tendency of yield increase expressed by the relations :

$$\text{Rate of } P_0 \quad yN_0 = 18.60 + 1.1133\,x\,;\ r = 0.640$$
$$yN_{50} = 18.39 + 1.282\,x\,;\ r = 0.607$$
$$yN_{100} = 18.81 + 1.202\,x\,;\ r = 0.529$$

$$\text{Rate of } P_{70}\ yN_0 = 22.10 + 0.895\ x\ ;\ r = 0.631$$
$$yN_{50} = 23.36 + 0.787\ x\ ;\ r = 0.493$$
$$yN_{100} = 23.06 + 0.967\ x\ ;\ r = 0.608$$

where y = the respective yield (q/ha)
x = the experimental years (1959 = 1, 1960 = 2,...,1967 = 9).

Although the calculated values for the correlation coefficients (r) are smaller than the corresponding theoretical value, attached to the probability level of 5% (r = 0.67), yet we may consider that there is a real correlation between the two values (xy and x) expressed by the respective equations — due to the small and constant differences between the calculated value of "r" and "r—5%". The small values of the "r" coefficients are mainly due to the insufficient number of years (9) considered. From the previous equations it results the small influence of the N-fertilization upon the sunflower yield, recording a gain of about 1 q/ha on P_{70} dressing only. There was no difference observed between the doses of N_{50} and N_{100}.

Table 3

Influence of NP fertilizers upon the sunflower yield on chocolate chernozem

Treatments	1959	1960	1961	1962	1963	1964	1965	1966	1967	Average 1959-1967	Average 1965-1967
P_0N_0	20.1	23.1	21.9	17.0	27.1	21.2	30.5	24.3	31.3	24.2	28.7
N_{50}	18.4	26.0	23.4	15.1	30.7	21.1	28.7	27.3	32.5	24.8	28.5
N_{100}	20.7	27.2	21.9	13.0	30.1	20.5	29.7	27.8	32.5	24.8	30.0
$P_{35}N_0$	21.1	25.4	23.8	20.2	28.7	24.9	29.4	26.0	31.9	25.7	29.1
N_{50}	22.6	28.9	24.0	18.2	30.4	25.0	29.1	27.7	33.9	26.4	30.2
N_{100}	20.3	27.7	24.8	19.9	30.5	23.9	31.1	27.7	32.4	26.5	30.4
$P_{70}N_0$	22.1	26.4	26.6	21.3	28.6	24.3	31.2	25.7	33.0	26.6	30.0
N_{50}	23.1	29.2	25.1	20.1	31.9	25.3	32.5	26.4	32.0	27.3	30.3
N_{100}	22.8	28.9	25.8	23.0	31.0	24.9	33.1	26.6	34.9	27.9	31.5

A much stronger influence was displayed by the P-fertilizers. Differences of 4—5 q/ha were recorded between the two levels : P_0 and P_{70}, regardless to the N-level. During the years, the yield increase obtained with the P-fertilization (P_{70}—P_0), showed a tendency to decrease — yet not significant — within the probability level of 5%. The progressive equations and the respective correlation indices are :

$$\text{Rate of } N_0\ \ y_1 = 3.39 - 0.208\ x\ ;\ r = -0.451$$
$$y_2 = 17.42 - 1.283\ x\ ;\ r = -0.452$$
$$\text{Rate of } N_{50}\ \ y_1 = 4.96 - 0.495\ x\ ;\ r = -0.614$$
$$y_2 = 25.39 - 2.633\ x\ ;\ r = -0.586$$
$$\text{Rate of } N_{100}\ \ y_1 = 4.24 - 0.235\ x\ ;\ r = -0.208$$
$$y_2 = 25.89 - 1.867\ x\ ;\ r = -0.214$$

where y_1 = the yield increase (q/ha) obtained with P_{70} (P_{70}—P_0)
y_2 = % yield increase (P_{70})

$$\left(\frac{P_{70}-P_0}{P_0} \cdot 100\right)$$

x = the experimental years (1959 = 1, 1960 = 2,...1967 = 9).

If we draw a comparison between the correlation coefficients corresponding to the different N-levels, it results that the reduction tendency of the P-fertilizer efficiency, is more visible for the N_0 and N_{50} doses, than for N_{100}. The average yield increase resulting from the P-fertilization and the nitrogen-phosphorus interaction were, according to the N_0, N_{50} and N_{100} levels, the following : 1.50 q/ha ; 1.80 q/ha ; 1.60 q/ha at P_{35} and 2.30 q/ha ; 2.50 q/ha and 3.10 q/ha for a double P-dose, respectively (table 4). It was thus observed a growth in the efficiency of the P-fertilizers in the presence of nitrogen, due to a positive NP interaction, yet not significant, compared to the P_{35}-dose, the P_{70} (double) dose brought a yield increase of 0.60—1.30 q/ha, i.e. 3.1—6.5%.

Table 4

The yield increase achieved by using P fertilizers — q/ha

Years / Treatments (P_2O_5, N)	P_{35} — P_0			P_{70} — P_0			P_{70} — P_{35}		
	N_0	N_{50}	N_{100}	N_0	N_{50}	N_{100}	N_0	N_{50}	N_{100}
1959	1.0	4.2	—0.4	2.0	4.7	2.1	1.0	0.5	2.1
1960	1.3	2.9	0.5	2.3	3.2	1.7	1.0	0.3	1.2
1961	1.9	0.6	2.9	4.7	1.7	3.9	2.8	1.1	1.0
Average: 1959—1961	1.4	2.6	1.0	3.0	3.2	2.6	1.6	0.6	1.4
1962	2.6	3.1	6.9	3.7	5.0	10.0	1.1	1.9	3.1
1963	1.6	—0.3	0.4	1.5	1.2	0.9	—0.1	1.2	0.5
1964	3.7	3.9	3.4	3.1	4.2	4.4	—0.6	0.3	1.0
Average: 1962—1964	2.6	2.2	3.6	2.8	3.5	5.1	0.1	1.1	1.5
1965	—1.1	0.4	1.4	0.7	3.8	3.4	0.7	3.4	2.0
1966	1.6	0.4	—0.1	1.4	—0.9	—1.2	—0.3	—1.3	—1.2
1967	0.6	1.4	—0.1	1.7	—0.5	2.4	1.1	—1.9	2.4
Average: 1965—1967	0.4	0.7	0.4	1.3	0.8	1.5	0.5	0.1	1.1
Average: 1959—1967	1.5	1.8	1.6	2.3	2.5	3.1	0.7	0.6	1.3
Total average		1.6			2.6			0.9	

In order to explain the considerable variation of the response to fertilization over the respective experimental period, the correlation coefficients between the precipitations recorded at different periods, the production level and the yield gains obtained with nitrogen and phosphorus were calculated. (table 5).

Table 5

Influence of rainfall on the yield level and fertilizer response on sonflower. Coefficients of correlation

	Yield N_0P_0	Yield increase to P*				Yield increase to N			
		Without N		With N*		P_0 dressing		P_{70} dressing	
		q/ha	%	q/ha	%	q/ha	%	q/ha	%
Water reserve in:									
October-March	0.493	—0,340	—0,385	—0.629	—0.433	—0.414	0.364	—0.070	—0.095
October-April	0.341	—0.160	—0.220	—0.587	—0.413	0.379	0,343	—0.266	—0.285
October-May	0.631	—0.460	—0.520	—0.634	—0.548	0.356	0.366	—0.046	—0.093
Water reserve in:									
October-March+May	—0.775*)	—0.644	—0.686*)	—0.638	—0.580	0.360	0.365	0.174	0.120
May	0.649	—0.670*)	—0.671*)	—0.114	—0.306	—0.046	0.057	0.485	0.422
June	—0.068	—0.275	—0.327	—0.291	—0.302	0.338	0.358	0.338	0.406
July	—0.540	0.110	0.180	0.259	0.225	—0.162	—0.144	0.011	0.079
August	—0.186	0.267	0.164	0.063	—0.10	0.007	0.063	—0.295	—0.261

*) Average N_{50} and N_{100}

r (n = 9; P = %5) =0.67

Table 6

Influence of fertilizer application methods on N and P absorbtion by the sunflower plants, during the vegetation period — Fundulea 1971

Treatments (kg/ha)				Dry weight from lo plants	Absorbed N (g)		„A" value	Absorbed P_2O_5 (mg)		„A" value
Broadcast		Strip			Total	from fertilizer		Total	from fertilizer	
N	P_2O_5	N	P_2O_5							
—	—	—	—	21.1	0.803	—	—	164	—	—
80	—	—	—	26.5	1.145	0.457	118	213	—	—
—	—	80	—	21.4	0.924	0.420	96	149	—	—
80	40	—	—	25.9	1.196	0.440	137	222	2.1	3960
80	80	—	—	24.3	1.058	0.396	133	202	5.3	2800
80	120	—	—	26.8	1.187	0.425	144	209	6.2	3880
—	—	80	40	34.9	1.525	0.788	75	297	50.4	191
—	—	80	80	39.9	1.736	0.916	72	372	65.5	382
—	—	80	120	36.9	1.677	1.020	51	378	92.6	370
80	—	—	40	28.1	1.195	0.449	133	247	8.8	988
80	—	—	80	31.1	1.539	0.587	130	267	12.2	1349
80	—	—	120	30.5	1.324	0.485	137	234	23.8	1056

The production level (at N_0P_0) is positively influenced by the water reserve and especially by the rainfall quantity in May. The highest correlation coefficient (0.775) was recorded with the water reserve accumulated during the October-March period adding up the rainfall from May. This means that the high production levels are obtained in those years when, on a rich winter reserves in the autumn-winter period, we also have abundant rainfall in May.

As for the response to fertilizers, it was noticed that the two main elements, nitrogen and phosphorus, react contradictorily to the precipitations level.

The reaction at phosphorus is being negatively influenced by the water reserve and the May-rainfall, while nitrogen causes a positive reaction.

The yield increase due to the P-fertilization on a N_0 level is both significantly and negatively correlated to the level of May rainfall (—0.670), while on a non-significant N level, this favourable influence of the precipitations on the N-efficiency prevails upon the influence on P-efficiency.

A similar, but inverse situation was recorded at the gains obtained with phosphorus on a nitrogen level as correlated to the water reserve. In this case, the water reserve accumulated, influences much stronger the P-fertilizers efficiency than the N-fertilizer one.

The negative effect of the precipitations from the autumn-winter-spring period, can be explained through a more significant mobility of the soil phosphates at a high humidity level. On the contrary, though the nitrogen's revaluation is superior, under the same conditions, to the phosphorus revaluation, yet the corresponding correlation coefficients are much smaller for nitrogen because the sunflower yield is primarily influenced — as we already know — by the phosphate fertility level.

In order to establish the necessary fertilizer doses, the average yield function was calculated on the period 1959—1967.

$$y = 24.24 + 0.0142\ N + 0.0483\ P - 0.00009\ N^2 - 0.00022\ P + 0.00010\ NP; \quad r = 0.997$$

where : y = sunflower yield (q/ha)

N and P = the respective doses in kg.a.s./ha of nitrogen and P_2O_5 respectively.

Analysing the respective coefficients it was noticed that — in the case of the chocolate chernozem soil — the sunflower yield is primarily influenced by the P-fertilization.

Also worth mentioning is the presence of a relatively high NP interaction in this case.

The isoquantums corresponding to the different yield levels inferred from the response surface as well as the agro-economical indices are represented in fig. 1 and 2.

The optimum yield (27.4 q/ha), from the economic point of view was obtained with 34.5 kg N a.s./ha and 83.3 kg P_2O_5/ha, according to the 9-year average. The maximum yield and the corresponding fertilizer

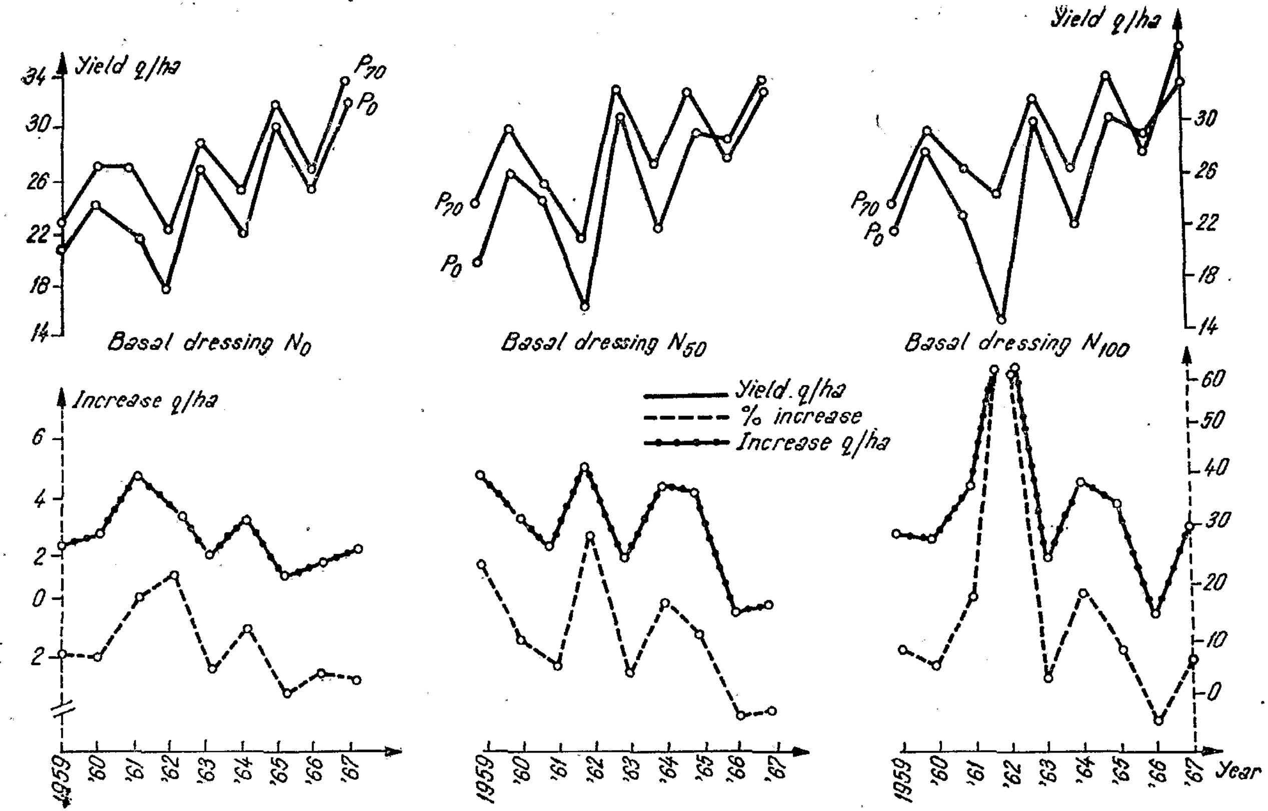

Fig. 1 — Effect of P-fertilization upon sunflower, according to the N-level provided cn chocolate chernozem soil of Ileana-Ilfov (1958—1967).

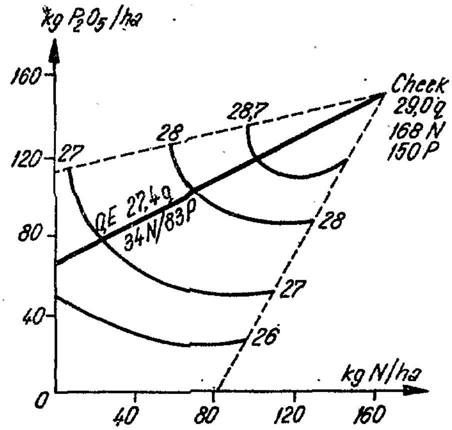

Fig. 2 — The isoproduction curves of the main technical and economical indices of sunflowers, cultivated on chocolate chernozem soil of Ileana-Ilfov (1959—1967).

doses present only a limited interval for the future theoretical experiments, as they go beyond the actual experimental range.

The predominant rôle held by phosphorus in the sunflower yield increase has been very clearly outlined through the "elasticity coefficients" (E) of the function. The following relations have been used for their calculation :

$$E_P = \frac{N}{P} \cdot \frac{dy}{dN} \quad \text{and} \quad E_N = \frac{P}{N} \cdot \frac{dy}{dP}$$

The corresponding values are 0.86 for P and 0.14 for N. This means that phosphorus contributes 86% to the respective yield increase while nitrogen only 14% (86 + 14 = 100).

In order to determine with precision the utilization coefficient of fertilizers by sunflower, a number of experiments were conducted at ICCPT-Fundulea using the stable isotope ^{15}N and the radioactive isotope ^{32}P, as well. These experiments also established the efficiency of the different methods of fertilizer application.

These experiments are being carried on within the National Nuclear Plan as the first research work on a world scale where, under field conditions, studies were carried out using stable and radioactive isotopes in sunflower.

Increasing nitrate doses were applied in 1970, i.e. 20, 40, 60, 80 and 100 kg N/ha as well as 30 kg P_2O_5/ha through strip-application and broadcasting.

The results obtained in the first year of the experiment (1970) revealed a superior utilization of phosphorus from the superphosphate as compared to the method where the fertilizers were applied over the entire surface.

The more intense absorbtion of phosphorus from the superphosphate was correlated to a stimulation of the green matter growth in the first vegetation stages as well as an increase in the seed yield.

Starting from these results, the experiment schedule was improved in 1971 as we can see in tables 6 and 7. The N-dose was maintained constant (80 kg N a.s./ha) ; meanwhile using increasing doses of phosphorus ; i.e. 40, 80 and 120 kg P_2O_5/ha, applied either together in strips/broadcasting or separately in strips/broadcasting.

In the year 1971, the absorbtion of nitrogen and phosphorus by sunflower was studied both during the growth period (table 6) and during the final harvesting (table 7).

In the case of strip application of phosphorus with nitrogen, a very strong absorbtion of phosphorus from the fertilizer was observed. The absorbtion increased with the increase of the P-dose. This absorbtion is clearly superior both to the application of the same doses through broadcasting and to the separate application of nitrogen through broadcasting while phosphorus is applied in strips. The smallest absorbtion of phosphorus from the fertilizer was recorded in the case of the NP fertilizers application through broadcasting.

The N-absorbtion from the fertilizer is clearly superior at the joint application of nitrogen and phosphorus in strips, as compared to the separate, broadcasting application. This can be explained through an activation of the vegetable mass growth. Thus, the 10-plants dry matter reached more than 35 g at the joint strip-application, about 30 g at the separate application of N and P and, finally, about 25 g at the joint application through broadcasting.

The N-absorbtion in the sunflower stems, leaves, heads and seed was studied in 1971 at the final harvesting (table 7). The P-absorbtion could no longer be studied as there was no chance for the further recording of the ^{32}P-isotope activity. It was also observed that both the total quantity of absorbed nitrogen and the nitrogen quantity from the fertilizer is to be found mostly in the seed, while the smaller quantities can be found in the heads. There is a very slight increase of the N-absorbtion in all the three plant-sections with the joint, strip-application of nitrogen and phosphorus ; in this situation, a slight increase of the N-absorbtion is observed with the increase of the P-dose.

The experiments carried out in the year 1972 had as an aim to determine the utilization coefficient of the nitrogen in connection with the applied dose and the P-dressing of the soil (table 8). The total quantity of absorbed nitrogen increases, per plant, with the growth of the N-dose on all the three P-dressings ; this increase is particularly visible in the case of the fertilizer-absorbed nitrogen. No differentiation can be made in point of total N-quantity or fertilizer-absorbed nitrogen correlated to the P-dose. The highest N-utilization coefficient (considerable, in general), was recorded for the dose N_{60} on a 30 kg and 90 kg of P_2O_5-dressing.

The data listed in this table also point out to the fact that nearly equal N-quantities are absorbed by the head and seed — while the N-quantity from the fertilizer is basically the same. Smaller N-quantities were absorbed by stems.

Table 7

Influence of fertilizer application methods on the N absorption by the sunflower plants — Fundulea 1971 —

Treatments kg/ha				Stems and leaves					Heads					Seed				
Broadcast		Strip		Yield q/ha	N %	Ndff %	Absorbed N kg/ha		Yield q/ha	N %	Ndff %	Absorbed N kg/ha		Yield q/ha	N %	Ndff %	Absorbed N kg/ha	
N	P_2O_5	N	P_2O_5				Total	from fertilizer				Total	from fertilizer				Total	from fertilizer
—	—	—	—	41.7	0.42	—	17.5	—	15.3	1.22	—	18.7	—	18.0	2.57	—	46.3	—
80	—	—	—	43.5	0.60	34.5	26.1	9.0	13.5	1.22	24.0	16.5	4.0	19.4	2.74	29.1	53.2	15.5
—	—	80	—	43.4	0.58	36.7	25.2	9.2	15.1	1.20	30.8	18.1	5.6	21.4	2.43	27.3	52.0	14.2
80	40	—	—	45.6	0.56	31.3	25.5	8.0	13.2	1.32	29.8	17.4	5.2	17.6	2.59	26.8	45.6	12.2
80	80	—	—	47.2	0.59	37.2	27.8	10.3	13.5	1.23	32.0	16.6	5.3	20.0	2.67	30.9	53.4	16.5
80	120	—	—	46.1	0.57	33.2	25.8	8.6	15.0	1.25	29.4	18.8	5.5	22.3	2.60	27.8	58.0	16.1
—	—	80	40	48.0	0.57	33.9	27.4	9.3	12.6	1.38	27.5	17.4	4.8	21.1	2.69	26.4	56.8	15.0
—	—	80	80	48.0	0.59	36.3	28.3	10.3	14.8	1.44	29.5	21.3	6.3	21.6	2.70	27.8	58.3	16.2
—	—	80	120	48.1	0.56	36.6	26.9	9.8	15.6	1.42	30.2	22.1	6.7	23.5	2.67	28.5	62.7	17.9
80	—	—	40	45.4	0.58	31.7	26.3	8.3	14.5	1.30	31.2	18.8	5.9	19.5	2.63	29.1	51.3	14.9
80	—	—	80	48.0	0.52	31.9	25.0	8.6	14.1	1.24	28.1	17.5	4.9	21.0	2.59	26.4	54.4	14.4
80	—	—	120	47.3	0.48	33.6	22.7	7.0	13.1	1.26	32.8	16.5	5.4	21.8	2,59	28.9	56.5	3 16.

Table 8

The N absorbtion and utilization coefficients of the N fertilizer by sunflower as function of the NP application rate. Fundulea 1972

Treatments	Stems				Flowerheads				Seed				Total		
	Yield q/ha	Absorbed N kg/ha		Utilization rate %	Yield q/ha	Absorbed N kg/ha		Utilization rate %	Yield q/ha	Absorbed N kg/ha		Utilization rate %	Absorbed N kg/ha		Utilization rate %
		Total	From fertilizer			Total	From fertilizer			Total	From fertilizer		Total	From fertilizer	
N_0P_0	35.4	—	—	—	36.8	—	—	—	23.4	—	—	—	—	—	—
$P_{30}N_0$	40.5	—	—	—	36.6	—	—	—	23.7	—	—	—	—	—	—
N_{30}	38.8	22.9	3.4	11.3	37.1	64.9	10.1	33.7	25.5	63.2	8.8	29.3	151.0	22.3	74.3
N_{60}	36.1	22.4	7.1	11.8	36.3	66.8	21.0	35.0	26.0	72.8	20.1	33.5	162.0	48.2	80.3
N_{90}	33.1	24.2	10.2	11.3	36.9	71 6	30.9	34.3	26.0	68.9	26.7	29.7	164.7	67.8	75.3
$P_{60}N_0$	32.4	—	—	—	36.1	—	—	—	24.9	—	—	—	—	—	—
N_{30}	37.6	20.7	3.8	12.7	37.5	73.5	11.5	38.3	26.1	54.8	7.5	25.0	149.0	22.8	76.0
N_{60}	37.5	17.6	5.0	8.3	37.2	69.4	18.4	30.7	25.7	68.9	18.4	30.6	155.9	41.8	69.6
N_{90}	36.5	23.7	10.1	11.2	34.4	64.5	28.0	31.1	24.6	68.6	28 2	31.3	157.0	66.3	73.6
$P_{90}N_0$	40.2	—	—	—	36.3	—	—	—	24.1	—	—	—	—	—	—
N_{30}	38.5	22.3	3.1	10.3	35.8	65.5	10.1	33.7	25.3	68.8	9.5	31.7	156.6	22.7	75.7
N_{60}	37.6	15.4	4.1	6.8	36.9	71.2	23.4	39.0	25.1	69.0	20.6	34.3	155.6	48.1	80.1
N_{00}	34.8	26.1	8.9	9.9	34.8	67.5	27.0	30.0	25.5	76.8	29.0	32.2	170.4	64.9	72.1

As for the fertilizer influence upon the seed yield, a yield increase from 35.4 q/ha to more than 40 q/ha was remarked in 1972, — a year rich in precipitations — through the application of P-fertilizers. The production decreased with a furter increase of the N-dose.

The experiment continued in 1973 in order to obtain more relevant results, thus selecting the N and P-doses as to have comparable data to those from some of the long-termn experiments using fertilizers (table 9). It was observed that, in the year 1973, with its excessively humid spring and very dry autumn, the calculated as well as the experimental N-dose, was smaller than in 1972 — thus resulting a smaller utilization coefficient. The highest value for the N-utilization coefficient was obtained with a dose of 40 kg N a.s./ha with or without phosphorus. However, the highest values of the N-utilization coefficient are obtained on a level of 80 kg P_2O_5/ha. The quantity of absorbed nitrogen from the fertilizer increases with the N-dose, both in the different plant sections and per plant total.

Table 9

The N absorbtion and utilization coefficient of the N fertilizer by sunflower as function of the NP application rate — Fundulea 1973

Treatment	Stems				Seed				Total		
	Yield q/ha	Absorbed N		Utilization rate %	Yield q/ha	Absorbed N		Utilization rate %	Absorbed N		Utilization rate %
		Total	from fertilizer			Total	from fertilizer		Total	from fertilizer	
$P_0 N_0$	50.0	—	—	—	28.9	—	—	—	—	—	—
N_{40}	50.5	32.8	8.0	20.0	33.9	73.9	16.7	41.7	106.7	24.7	61.7
N_{80}	45.8	35.7	13.4	16.7	33.7	85.9	29.5	36.7	121.6	42.9	53.4
N_{120}	47.0	41.4	23.6	19.6	34.6	92.4	48.1	40.1	133.8	71.7	59.7
$P_{40}N_0$	54.6	—	—	—	30.4	—	—	—	—	—	—
N_{40}	50.7	37.0	8.9	22.3	33.3	75.2	15.3	38.2	112.2	24.2	60.5
N_{80}	57.3	46.4	17.3	21.6	34.6	81.7	29.1	36.3	128.1	46.4	57.9
N_{120}	45.2	36.6	19.7	16.4	36.8	87.9	46.1	38.4	124.5	65.8	54.8
$P_{80}N_0$	46.8	—	—	—	29.7	—	—	—	—	—	—
N_{40}	49.8	34.4	9.7	24.2	34.6	75.4	18.3	45.7	109.8	28.0	69.9
N_{80}	52.8	37.5	15.8	19.7	36.8	88.3	33.9	42.3	125.8	49.7	62.0
N_{120}	46.5	45.1	26.3	21.9	36.6	95.9	51.3	42.7	141.0	77.6	64.6

As far as the fertilizer influence upon the sunflower yields is concerned, the dose of 40 kg N a.s./ha was found to increase the yield by 5 q/ha, while a further increase of the N-dose brought no further yield gain. In the year 1973, phosphorus alone brought little increase. As for the medium leached chernozem from Fundulea, phosphorus brought no further yield increase, even when applied with nitrogen.

In the last years, special attention was given to the study of the fertilizer revaluation capacity by the new varieties and hybrids created by breeders. Table 10 list the results obtained in the last 3—4 years at Fundulea, Podu Iloaie and Secuieni where the behaviour of the hybrids Romsun 52 and 53 was studied, comparatively to the variety Record — at different fertilization levels.

Table 10

The effect of fertilizers on various hybrids as compared to the Record variety

Place	Variety	N_0P_{80}	$N_{40}P_{80}$	$N_{80}P_{80}$	$N_{120}P_{80}$	Average
Fundulea 1971—1973	Record	26.3	28.7	28.4	27.6	27.8
	HS-52	26.5	29.0	28.5	27.9	28.0
	HS-53	27.0	28.1	28.2	27.5	27.7
	X	26.6	28.6	28.4	27.7	
Secuieni 1972—1973	Record	24.1	26.0	27.8	25.9	25.9
	HS-52	26.1	27.6	27.1	26.6	26.8
	HS-53	27.6	29.1	30.0	27.4	28.5
	X	25.9	27.6	28.3	26.6	
Podu Iloaie 1972—1973	Record	16.6	18.7	18.5	21.2	18.7
	HS-52	19.6	20.2	21.7	23.1	21.2
	HS-53	19.5	21.4	23.1	24.3	22.1
	X	18.6	20.1	21.1	22.9	

The production levels of the three varieties and hybrids experimented at Fundulea were quite similar. In all the cases, the maximum yield was obtained with $N_{40}P_{80}$, while a further increase of the N-dose diminished the respective yield.

Nevertheless, on the brown chernozem-like soil from Secuieni, a more clear differentiation was made within the 3 varieties, where the Record variety was flatly surpassed by Romsun 53 ; the hybrid Romsun 52, however, had a less promising behaviour, under the given conditions. On this soil, the highest yield was obtained on a basal dressing of $N_{80}P_{80}$.

The highest differentiation, however, was obtained on the leached-chernozem from Podu Iloaie, where Record was surpassed by the both hybrids. The highest yields were obtained with Romsun 53. The productions continuously increased — on this soil — with the growth of the fertilizer dose.

As the fertilizer production increased in our country, their range was also enriched, thus it was necessary to study their efficiency upon the sunflower seed yield, too.

Thus was studied the efficiency of the ammonium nitrate, urea and the ammonium sulphate. The results indicated no differences between the yields achieved with the different fertilizer varieties.

As larger and larger quantities of compound fertilizers have been used lately, we shall present the results obtained at Brăila (the experimental station where the fertilizers achieved the highest yield gains), using these fertilizers, as compared to the results obtained with simple fertilizers (table 11). There were no yield differences between the two types of fertilizers applied either in autumn or spring (considering the active-substance equivalent application) yet, the compound fertilizers have a number of well-known economical advantages.

Table 11

Effect of compound fertilizer on sunflower yield in comparison with simple fertilizers
Brăila — 3-year average

Treatment	In autumn		In spring	
	q/ha	diff.	q/ha	diff.
Control	25.0	—	25.0	—
$N_{50}P_{50}$ simple fertilizer	31.6	6.6	29.5	4.5
$N_{50}P_{50}$ complex fertilizer 16—48—0	30.0	5.0	29.5	4.5
$N_{50}P_{50}$ complex fertilizer 23—23—0	28.9	3.9	28.3	3.3
$N_{50}P_{50}$ complex fertilizer 13—26—13	31.8	6.8	30.0	5.0

It results, from all that was said so far, that a rational application of the fertilizers will achieve high and constant sunflower yields.

CONCLUSIONS

1. The application of inorganic fertilizers at sunflower will achieve the highest yield gains (2.4—5.9 q/ha) on the carbonated chestnut chernozem, chestnut chernozem and the chocolate chernozem.

2. The most important factor — for the yield increase — irrespectively of the soil-type, is the interaction between nitrogen and phosphorus.

3. The N-fertilizers may lead to the yield decrease, on the podzolized soils (like that from Oradea) due to the soil acidification, regardless to the chemical composition of the fertilizer.

4. The reaction to phosphorus is being negatively influenced by the water reserve and precipitations, in May, while the reaction to nitrogen is, on the contrary, positively influenced.

5. The strip and joint application of the N and P-fertilizers causes an increase of the phosphorus absorbtion and stimulates the vegetable mass. The strip-application of the nitrogen and phosphorus leads to a more economical and efficient utilization of the fertilizers.

6. The highest coefficient (80%) of fertilizer utilization, was achieved in 1972, using doses of $N_{60}P_{30}$ and $N_{60}P_{90}$. The utilization coefficient of the N-fertilizers increases with the N-dose applied.

7. Among the newly-created hybrids is remarked Romsun 53, which flatly surpasses the Record variety in the zones where it is released.

8. The compound fertilizers achieve the same yields as the simple ones, applied with regard to the equivalence of the respective active substance.

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