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DRY MATTER ACCUMULATION AND NITROGEN PHOSPHORUS, AND POTASSIUM ASSIMILATION BY SUNFLOWER HYBRID NS-H-26-RM

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INTRODUCTION

To grow sunflower successfully and to apply adequate quantities of fertilizers it is necessary to know specific characters of accumulation of dry matter and assimilation of essential nutrients during the growing season. To follow the balance of nutritive substances, we must know the distribution of nutrients in individual plant parts. These data differ for each region and group of related sunflower hydrids. The need for these data was emphasized by a rapid replacement of sunflower varieties by sunflower hydrids in commercial production. Consequently, we decided to examine the accumulation of dry matter and assimilation of N, P, and K during the growing season of sunflower hybrid NS-H-26-RM when grown in the region of Vojvodina. This hybrid is grown on the largest area and Vojvodina is the region of most intensive sunflower growing.

MATERIAL AND METHOD

Field trials were conducted in 1977, 1978, and 1979 on chernozem soil of good physical and chemical properties, i.e., high fertility. Latin square design was used. The tested hybrid, NS-H-26-RM, has 10 days shorter vegetation than Peredovick. There were 57,000 plants per hectare (70 x 25 cm). All test variants were fertilized with 100 kg/ha of P_2O_5 and K_2O. Three variants were fertilized with 60

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kg/ha of N; nitrogen was not added to the control variant. The samples of plant material, taken at different stages of plant development (as given in Tables), were first dried at room temperature and then at 80° C prior to the analysing. Separate samples were dried at 105° C for the calculation of absolutely dry matter weight. A mixture of H_2SO_4 and $HClO_4$ was used for digestion; after digestion, the solution was diluted to 100 ml. N was determined after Kjeldahl, P spectrometrically, and K flamephotometrically.

RESULTS AND DISCUSSION

There were no large differences in the examined characters among the variants of fertilization and test years. All results will, therefore, be presented as averages of variants and years.

Figure 1 shows the patter of dry matter accumulation during the growing season; absolute and relative values of accumulation are given in Tables 1 and 2. The largest portion of dry matter was accumulated in the period from budding to the end of seed filling —141 a/ha or 96.6%. Within this period, the most intensive accumulation took place at the stage of flowering and seed filling —112.4 q/ha or 77.4%. These data show the importance of providing conditions which allow sunflowers to accumulate such enormous quantities of dry matter in a short interval.

At the stage of full maturity, the total quantity of dry matter was somewhat smaller due to various reasons: damages caused by late disease attacks (head rot), partial leaf shedding, etc. The percentages

TABLE 1

Accumulation of dry matter and assimilation of N,P and K at different stages of development of NS-H-26

Stage	Dry matter q/ha	N	P_2O_5 q/ha	K_2O
2 leaves	0,3	1,3	0,2	0,7
6 leaves	5,0	20,5	2,8	12,3
Budding	33,8	95,4	14,9	78,4
Flowering	77,6	158,9	37,0	225,0
Seed filling	146,2	206,8	80,0	306,5
Full maturity	120,5	174,8	81,7	262,9

TABLE 2

Relative accumulation of dry matter and assimilation of N,P and K, at different stages of development of NS-H-26 (% of maximum)

Stage	Dry matter	N	P	K
2 leaves	0,2	0,8	0,2	0,3
6 leaves	3,3	9,6	3,3	3,8
Budding	19,2	35,3	14,4	18,9
Flowering	33,6	31,0	27,0	50,9
Seed filling	43,8	23,6	52,0	26,1
Full maturity	-17,5	-15,8	2,0	-17,0

TABLE 3

*Distribution of total fry matter N,P and K in plant parts of NS-H-26 (three-year average, 1977/79)**

Plant part	Dry matter		N		P_2O_5		K_2O	
	q/ha	%	kg/ha	%	kg/ha	%	hg/ha	%
Whole plant	120	100	175	100	82	100	263	100
Stem	35	29	20	11	4	6	94	36
Leaf	21	18	23	13	4	5	27	10
Head	22	18	17	10	7	8	108	41
Seed	43	35	115	66	66	81	32	12

* Data for the average of all variznts at full maturity

of dry matter accumulated at the stage of full maturity in the stem, leaf, head, and seed were 29, 18, 18, and 35, respectively (Table 3).

At the beginning of the vegetation, the highest concentration of N was found in the leaf —4.5%. The concentration of N decreased with the senescence in all plant parts save the seed. At the end of the vegetation, the percentages of N in the stem, leaf, head, and seed were 0.5, 1.1, 0.8, and 2.6, respectively. The highest concentration of P was found in the seed (1.5%). The concentration of P decreased with the senescence in all plant parts. The concentration of K was high in the vegetative parts (1.2—5.0%) and lowest in the seed (0.74%). The content of K did not very much during the vegetation (2.31—3.00%); conversely, a considerable decrease was registered in the leaf (2.30—1.22%) but a significant increase in the head (1.96—5.07%) (Table 4).

TABLE 4

N, P and K contents in certain plant parts at certain stages of development of NS-H-26 RM

Stage	Stem			Leaf			Head			Seed			Whole plant		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
2 pairs of leaves	4,2	0,54	2,33										4,2	0,54	2,33
6 pairs of leaves	2,4	0,51	2,96	4,5	0,59	2,30							4,1	0,56	2,46
Budding	1,7	0,41	2,65	3,6	0,49	2,17	3,4	1,04	1,96				2,8	0,44	2,32
Flowering	1,0	0,35	3,00	3,1	0,43	2,80	2,6	0,89	2,58				2,0	0,48	2,90
Seed filling	0,5	0,13	2,51	2,1	0,32	1,98	0,8	0,38	3,75	2,3	1,37	0,87	1,4	0,550	2,09
Full maturity	0,5	0,13	2,59	1,1	0,22	0,8	0,32	5,07	2,6	1,51	0,74	1,4	0,68	2,18	

The pattern of N assimilation resembled the patter of dry matter accumulation except that it was somewhat more intensive at earlier growth stages (Figure 1, Tables 1, 2, and 3). The average total assimilation was about 175 kg/ha.; 66% of it were assimilated by the seed (Table 3). The most intensive P assimilation started later, at the stage of flowering —seed filling. The total uptake was 82 kg/ha; 81% of it were taken up by the seed (Figure 1, Table 1, 2, and 3). The assimilation of K was most intensive at the stage of flowering (51%). The total uptake was 263 kg/ha; the seed, stem, head, and leaf assimilated 13, 36, 41, and 10%, respectively.

L. Gachon (1972) found that the hybrid INRA 65-01 had the most intensive absorption of nutrients during the two-month period before and after the flowering. In this period, the plants absorbed approximately nine tenth of the total quantity of Mg, three quarters of K, and two thirds of N, Ca and P. R.G. Robinson (1970, 1973) examined the concentration of numerous major and secondary macro- and microelements at 13 stages of sunflower growth. The concentration of N, S, P, K, Ca, Mg, Fe, Na, Sr, Zn, Cu, Mo, Mn, and B in stems, leaves, and receptacles decreased with the senescence; during the maturation, the seed had larger quantities of N, P, Zn, and Cu; the vegetative parts were richer with K, Ca, Mg, Sr, and B. In Yugoslavia, similar studies were conducted by T. Vrebalov (1974) and B. Jocic (1978) on varieties VNIIMK and Peredovic. Our study has some similarities but also some differences in comparison with theirs. The general pattern of dry matter accumulation was similar in all experiments. The total quantities of dry matter differed —NS-H-26-RM was superior although it is earlier and shorter than the varieties it was compared against. Also, the hydrid had a relatively higher accumulation of dry matter in the seed than in the vegetative parts, unlike the varieties. Finally, the hybrid had proportionally higher yields, total N, P, and K assimilation, and N, P, and K distribution in the seed, all that as the result of heterosis.

ABSTRACT

Three-year field trials were conducted on chernozem soil to examine the accumulation of dry matter and assimilation of N, P, and K during the growing season of sunflower hybrid NS-H-26-RM. Largest portions of dry matter and nitrogen were accumulated at the stages of flowering and seed filling. Concentrations of N, P, and K decreased in all vegetative parts with the exception of potassium in

the head and stem. The total assimilation was approximately 175 kg/ha, 82 kg/ha, and 263 kg/ha of N, P_2O_5, and K_2O, respectively.

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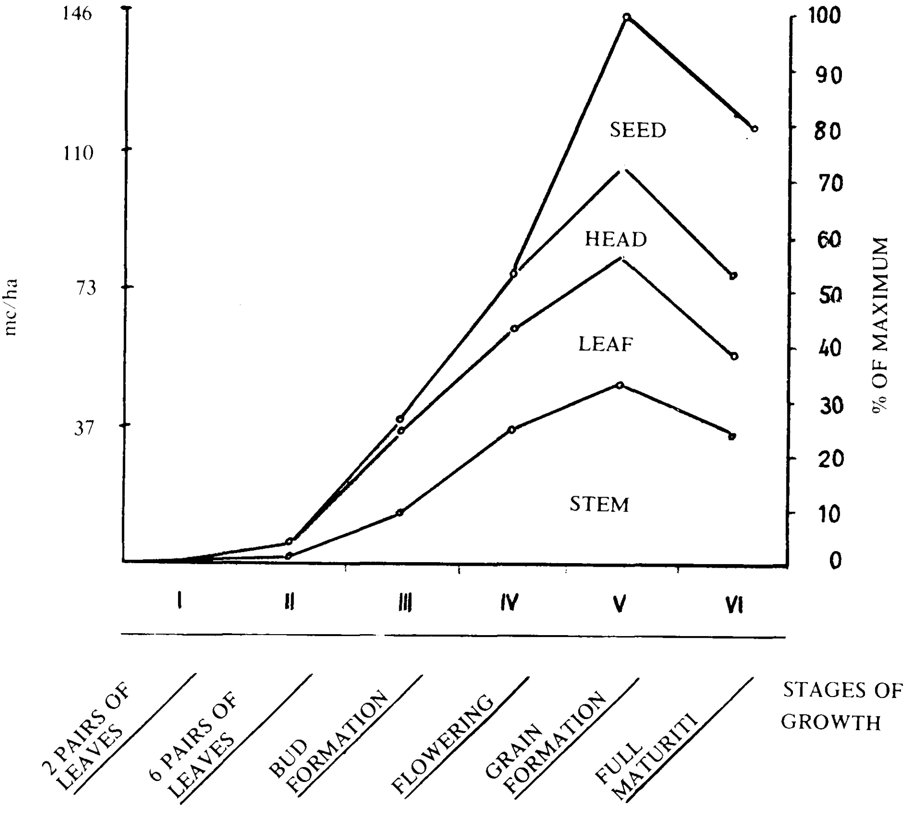

Figura 1a.—Dry Matter accumulation by sunflower NS-H-26-RM at different stages of growth (Average 1977/79)

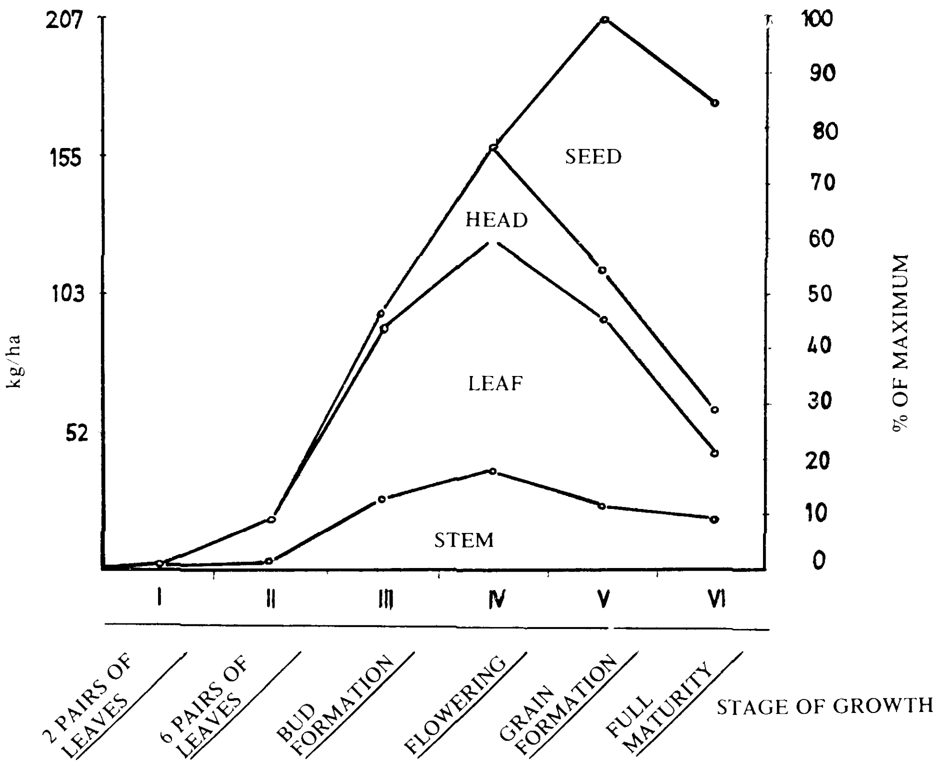

Figura 1b.— Nitrogen uptake by sunflower NS-H-26-RM at different stages of growth (Average 1977/79)

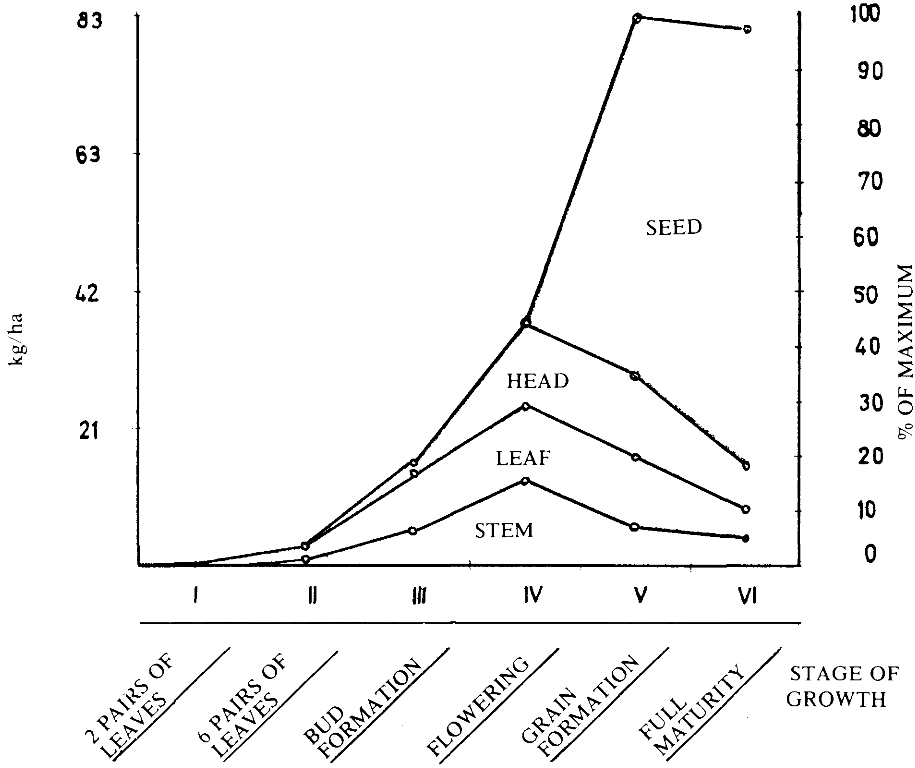

Figura 1c.— Phosphorus uptake by sunflower NS-H-26-RM at different stages of growth (average 1977/79)

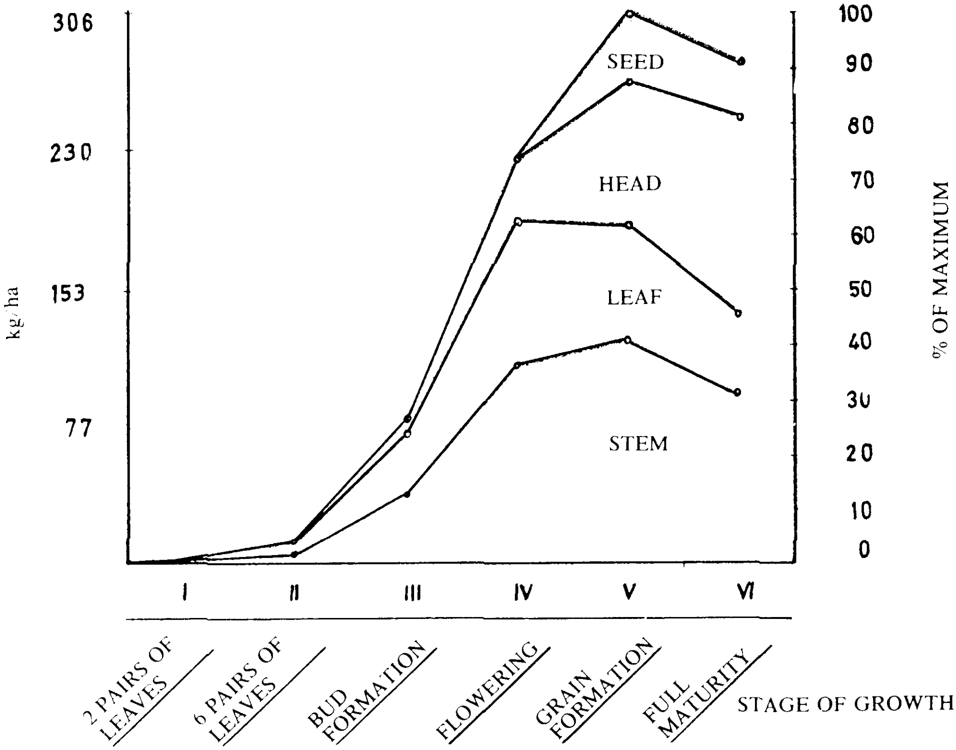

Figura 1d.— Potassium uptake by sunflower NS-H-26-RM at different sages of growth (average 1977/79)