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A STUDY ON LEAF AREA INDEX AND NET ASSIMILATION RATE OF SUNFLOWER (*HELIANTHUS ANNUUS* L.) VARIETY PEREDOVIK AS AFFECTED BY GRADED DOSES OF NITROGEN AND PHOSPHORUS

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A field experiment was conducted during February to May, 1973 to study the leaf area index and net assimilation rat; of sunflower variety 'Peredovik' under different levels of nitrogen and phosphorus on red loam soil of Kerala. The results showed that maximum leaf area index was noticed at the highest level of 90 kg N/ha at all stages. Phosphorus application also increased leaf area index at all stages of plant growth, though the effect was not consistent and conspicuous. Net assimilation rate showed an inverse relationship with leaf area index.

Watson (1947) introduced the concept of leaf area index (LAI) and Gregory (1917) that of net assimilation rate (NAR) as growth analysis techniques. According to Watson (1947) a combined measurement of these growth factors gives an index of the efficiency of crop canopy for photosynthesis and an efficient photosynthesising canopy will be the one that records a slower rate of decline of net assimilation rate with increase in leaf area index. As in the case of other crops, increase in vegetative growth and hence leaf area index with application of nitrogen has been recorded in sunflower (Galgo'czi 1969; Salageanu and Pristabu, 1966). Reports on the response to phosphorus had been less frequent under field conditions, though an increase in leaf production and leaf area index by artificial phosphorus supply in phosphorus deficient culture media has been observed (Fabian, 1970).

Materials and Methods

The field experiment was conducted at the farm attached to the College of Agriculture, Trivandrum during the period from February to May, 1973. The treatments consisted of factorial combinations of three levels of nitrogen, viz., 0, 45 and 90 kg N per hectare and four levels of phosphorus, viz., 0, 30. 60 and 90 kg P_2O_5 per hectare. Spacing adopted was 30 cm between rows and 15 cm between plants. Leaving two rows each on all sides as border, four plants were harvested at random per plot by cutting them at ground level for recording the observations on dry weight and leaf area. Leaves of these plants were separated and the area and dry weight of ten leaves sampled at random were found out. From the area and dry weight of these sub sample leaves, and total dry weight of the leaves of sample plants, leaf area index was calculated using the formulae

$$\frac{\text{Area of sample leaves}}{\text{Weight of the sample leaves}} \times \frac{\text{Total dry weight of leaves of sample plants}}{\text{Space occupied by the number of sample plants}}$$

Net assimilation rate at the different stages was calculated using the formula as suggested by William (1946),

$$NAR = \frac{Dw_2 - Dw_1}{(LAI_2 + LAI_1) \quad (t_2 - t_1)}$$ where

Dw_2 — Total dry weight at second stage
Dw_1 — Total dry weight at first stage
LAI_2 — Leaf area index at second stage
LAI_1 - Leaf area index at first stage
(t_2-t_1) Time interval between observations in days

Results and Discussion

Leaf area index

The data showing the mean leaf area index at different levels of nitrogen and phosphorus are given in Table 1. The data reveal that the effect due to nitrogen was significant at all three stages of plant growth. Between levels of nitrogen, maximum leaf area index was noticed at the 90 kg level at all stages followed by 45 kg and then by control of no nitrogen supply, the differences between these levels being singnificant. The favourable effect of nitrogen up to 90 kg/ha on development of leaves is thus brought out. The continued response of leaf area index to successive increments of nitrogen dose thus indicates that soil supplies of this nutrient were inadequate to maintain a high leaf area.

Levels of phosphorus also recorded significance at all three stages of observation. On 20th day, phosphorus at 90 kg P_2O_5/ha which was at par with 60 kg P_2O_5/ha was found to be significantly superior to 0 and 30 kg. During flowering stage, there was no difference between phosphorus levels of 30, 60 and 90 kg P_2O_5 ha which was at par with 90 kg, was found to be significantly superior to 30 and O kg P_2O_5/ha.

As evidenced by the protracted response to phosphorus levels at the various stages, and tne consistent increase in leaf area index only up to the level of 30 kg P_2O_5/ha , it appears that there had been soil supplies of this nutrient more or less adequate enough to sustain optimum vegetative growth.

Interaction between nitrogen and phosphorus remained non-significant.

Over stages, there was progressive increase in leaf area up to harvest. The trend of increase remained the same for all the different treatments.

Net assimilation rate

Net assimilation rates for various treatments are presented in Table 1. The data relate to the stages between 20th day of planting and flowering and that between flowering and harvest. Up to flowering, levels of nitrogen showed no significant differences. However a numerical decrease in net assimilation rate was noticed with increasing levels up to 90 kg/ha. The effect of nitrogen was significant between all the successive levels at the

Table 1

Effect of levels of nitrogen and phosphorus on leaf area index and net assimilation rate of sunflower plants at various stages of growth

Treatments	Leaf area index – Stages of growth: 20 days	Flowering	Harvest	Net assimilation rate (g/dm^2/week) – Stages of growth: Between 20th day and flowering	Between flowering and harvest
[eve's of Nitrogen in Kg/ha					
0	0.29	0.70	1.42	0.42	0.41
45	0.38	1.34	2.22	0.46	0.32
90	0.50	2.21	2.78	0.45	0.25
F. test	Sig	Sig	Sig	N. S.	Sig
S. Em ±	0.05	0.16	0.87	0.08	0 02
CD (0.05)	0.08	0.24	0.41		0.06
Levels of Phosphorus in P_2O_5/ha					
0	030	1.19	1 87	0.46	0.38
30	0.38	1.39	2.12	0.46	0.32
60	0.40	1.52	2.45	0.46	0.32
90	0.48	1.57	2.12	0.41	0.29
test	Sig	Sig	Sig	N. S.	N.S.
	0.05	0.16	0.87	0,08	0 02
(0.05)	0.09	0.27	0.47		

stage between flowering and harvest. This decrease in net assimilation rate due to nitrogen application may be attributed to the effect of this nutrient on the relative rates of photosynthesis and respiration. It may be noted that there was a significant increase in vegetative growth with increase in doses of nitrogen up to harvesting time. This enhanced vegetative growth due to nitrogen at 90 kg over 45 kg, and 45 kg over 0 kg should be expected to increase the respiration of plants markedly. Increased leaf area at higher doses of nitrogen level also might have resulted in an increase in mutual shading of leaves with a resultant decrease in photosynthetic activity. The overall net photosynthesis per unit of photosynthesising tissue (NAR) thus came down. The inverse relationship between net assimilation rate and nitrogen supply was not significant up to flowering. This was contrary to the expectation especially in this variety which had broad and more or less horizontal leaves. However, a comparison of data on leaf area index will clarify this. The mean leaf area indices at the level of 90 kg N/ha were 0.50 and 2.21 on 20th day and flowering respectively with a mean of 1.36. This leaf intensity was probably inadequate to offer a significant degree of mutual shading and hence bring down net assimilation rate. At the subsequent stage of NAR measurement when the corresponding LAI values were 2.21 and 2.78 respectively, with a mean of 2.50, significant decline in leaf efficiency for photosynthesis (NAR) was observed consequent to increase in nitrogen supply.

The effect of phosphorus and that of interaction between nitrogen and phosphorus on NAR were non-significant. It may be noted that the interaction effect on LAI was also non-significant and that of the individual effect of phosphorus, inconsistent over the varying levels.

Between stages a decreasing trend was noticed with advance in growth. A reverse trend of increase was observed in the case of leaf area index.

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സംഗ്രഹം

പെറഡോവിക് എന്നയിനം സൂര്യകാന്തിച്ചെടിക്ക്, നൈട്രജൻ, ഫോസ്ഫറസ്, എന്നിവ പല അളവുകളിൽ നൽകി 1973 ra?> fflOJggocoerDlcoTffiej ചുവന്ന ലോം മണ്ണിൽ നടത്തിയ ഒരു പരീക്ഷണത്തിൽ, ചെടിയുടെ എല്ലാ വളർച്ച ദശയിലും ഏററവും കൂടിയ ലീഫ് ഏറിയ ഇൻഡക്സ് (എൽ. ഏ. ഐ.) ഹെക്ടറിന് 90 കിലോഗ്രാം നൈട്രജൻ എന്ന തോതിൽ

ചേർത്തപ്പോഴാണ് ലഭിച്ചത്. [illegible] പ്രകടശ്രുപത്തിൽ അല്ലെങ്കിലും [illegible] ളായ ഇൻഡക്സ് വർദ്ധിപ്പിക്കുന്നതായി കണ്ടു. ലീഫ് ഏരിയ ഇൻഡക്സും നെറ്റ് അസ്സിമിലേഷൻ റേറ്റും (എൻ. എ. ആർ) roimEnroi വിപരീത ബന്ധമാണ് പ്രകടമായത്.

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