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The Effect of some Plant Growth Regulators (PGRs) on photosynthetic efficiency of Sunflower (*Helianthus Annuus L.)*

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Abstract

The experimental site was selected at TMIMT farm house. Delhi Road Pakwara, Moradabad and Plant Physiology lab Department of Botany Hindu P.G. College, Moradabad, U.P. Almost similar trend of effects was obtained when photosynthetic efficiency was expressed either on leaf area basis (14c counts min^{-1}, cm) or on dry weight basis (14c counts min^{-1}, mg^{-1} dry weight). Most of the treatments except cycocel (50 ppm) and GAf (10 ppm) decreased photosynthetic 14Co, fixation when applied to 10 days old plants. The maximum reduction was caused by ethephon treatments. When applied to 40 or 55-days old plant, most of the hormonal sprays had slight inhibitory effect. However, ethephon spray (50 ppm) at 55-days caused marked increase in photosynthetic of both bottom and top leaves, but it was decreased by GA_3 (100ppm) treatment to the extent of 44.5% photosynthetic efficiency of upper leaf increased by 152 and 34% with 50 and 500 ppm ethephon, while 10 ppm GA_3 decreased it by 26 and 25.3%.

Key word- Phytohormones, GA_3, Ethephon, Cycocel, photosynthetic efficiency

Introduction

Plant growth regulators (PGRs) have been used in many field crops to control the vegetative growth and reduce the risk of logging. In barley, PGRs reduced lodging by shortening the culm base when applied early (Jung 1964; Kust 1985) or by decreasing the length of upper internodes when applied at late growth stages (Sanvicente et al., 1999 & Khalil and Rahman 1995). In cotton, foliar application of mepiquat chloride is an accepted cultural practice for the management of excessive vegetative growth in temperate areas (Kerby 1985; Constable 1995; Edmisten 1995). Such information for sunflower is limited. The discovery of phytohormones has opened new vistas upon the horizon of crop production. They have provided man with a powerful means of stimulating the growth and development of the plants. It is the plant growth and magic substance regulated, their so called Sunflower (Helianthus annuus L.) in an annual crop that can tolerate drought better than many other crops due to its high efficiency in extracting soil moisture (Fageria 1992). Additionally, non-oil seed sunflower cultivars grown under irrigation produce high yield and can be quite profitable.

The Sunflower is a major source of vegetable oil in countries like, U.S.S.R., Canada, Bulgaria, Rumonia etc. The oil yielding ability of whole seed is increased considerably from original 28% to 50%. Sunflower as an oil seed crop is a new introduction in India. It has, however, bun grown a fodder crop and ornamental plants since long.

During the past three year, the farmers have been shown interest in the cultivation of this crop. This is because of its high oil percentual. It is very well suited as a cooking medium either as liquid or after hydrogenation. It is thus seen that the potentialities of sunflower as a commercial oil seed crop in India are indeed very great. Sunflower, being day neutral has wider range of adaptability. Its cultivation has been done with equal success in temperature and subtropical climates as well as in countries of tropic belt. In India it has been

successfully grown in northern as well as in southern parts of the country. High humidity accompanied by extended cloudy weather and rainfall result in poor seed set and high plant mortality. Number of florets per head has a major effect on yield. It has fairly high degree of heritability and selection for large flower head which is correlated with floret number and better yields. Sunflower is mainly grown for its oil. The oil is used for culinary purpose, in preparation of vanaspati and in the manufacture of soaps and cosmetics. It is especially recommended for heart patients. It cake is rich in protein and is used as a cattle and poultry feed.

Sunflower belongs to the family composition and the genus Helianthus. The cultivated genotypes are characterised by a single stem terminating in a capitulum. Sunflower is protandrous in which the male and female elements mature at different times. There appears to be a time lag of 18-24 hours in the maturity of the male and female element so it is essentially a cross-pollinated plant, besides varying degree of self-incompatibility shown.

The present investigation was therefore under taken with following main objectives. Determine the response of morphophysiological parameter such as photosynthetic efficiency upper and lower leaves.

Materials and Methods

Photosynthetic efficiency (expressed as cpm/cm^2 leaf area) was found to be higher in lower leaf than that of upper leaf.

GA_3 (10, 25, 50, 100, 200, and 400 ppm) give best result (plant height, leaf number, stem diameter) comprise of Cycocel, & Ethephon in sunflower crop at 40, 55, 70 days. Adesh Kumar et al., (2019).

GA_3 Better performance at 400 and 800mg/l followed by 200, 100, 50, 25 and 10 mg/l compared to cycocel and Ethephon (at different concentration) Adesh Kumar et al., (2013). The present observation can be explained by suggesting that foliar application of Cycocel, GA_3 and Ethephon probably increased the oil content by accelerating the rate of photosynthesis plant growth regulators (PGRs) are excellent tools to help control undesirable stretch of floriculture crops. When used at the correct stage of development and rate, they provide excellent height control. Misapplications can lead to catastrophic result which lower plant quality.

Seven concentrations of each hormone 10, 25, 50, 100, 200, 400, 800 ppm as given below were sprayed at every stage of development.

Sprayed Treatment	Concentration (ppm)
Contral	water
GA_3	10, 25, 50, 100, 200, 400, 800
Cycocel	10, 25, 50, 100, 200, 400, 800
Ethephon	10, 25, 50, 100, 200, 400, 800

Thirty plants were sprayed for each concentration. The Plant

Growth Regulators (PGRs) at concentration, 10, 25, 50, 100, 200, 400, 800 mg/l were applied to the whole plant with a compressed air hand sprayer. At 2 to 3 leaves stage first spray was given followed by two more sprays at weekly intervals. The quantity of solution sprayed to each plant was 5ml to 6ml and this was kept constant for each treatment.

Twenty 20 at 0.01% used as surfactant. Distilled water along with surfactant was used for spray of control plants. Certified seeds of different cultivars have been obtained from Agronomy Department of G.B. Pant University of Agriculture and Technology, Pant Nagar (UA). All chemicals employed in this investigation were of Analytical grade Supplied by BDH (India) unless specified otherwise.

Dehydrated absolute ethyl alcohol was supplied by Bengal chemical company India. Etheral was supplied by Duchem, U.S.A. Gibberellic acid supplied by CDH (Central Drug House) (P) Ltd. Post Box No 7138, New Delhi-110002

Results and Discussions

At 40 day:

Data recorded after 3 week of spray on photosynthesis efficiency of lower (14th from top) upper (8th from top) leaves of different treatments are presented in Tables.

Photosynthetic Efficiency (expressed as cpm/gm dry wt.) was found to be higher in lower leaf than of upper leaf in all the items except ethephon 500ppm where the effect was just the reverse.

Photosynthetic efficiency of lower and upper leaves of plants given different treatments was not found to be significantly changed in most cases. However photosynthetic efficiency of lower leaf of plants sprayed with 400 ppm ethephon decreased

Table 1: Effect of phytohormones sprays to 55 days old sunflower plants on photosynthetic efficiency of upper and lower leaves, recorded after three weeks of spray

Treatments Phytochormones	Conc. (ppm)	cpm gm^{-1} dry weight Lower leaf	cpm gm^{-1} dry weight Upper leaf	cpm cm^{-1} leaf area Lower leaf	cpm cm^{-1} leaf area Upper leaf
(Control)	-	17598±94.0	13999±83.8	92.0±7.6	73.0±6.9
Cycocel	10	12750±80.0	13999±80.7	66.4±60.7	83.0±7.3
	25	12860±80.2	13112±82.6	78.6±5.8	84.2±7.8
	50	15979±89.5	13299±81.6	80.5±7.3	78.0±7.1
	100	15999±88.2	13170±92.4	82.6±7.4	78.2±8.2
	200	16000±89.7	13050±90.6	86.4±7.6	79.4±8.3
	400	16080±90.2	12000±90.7	88.3±7.8	80.6±6.7
	800	17170±90.6	11970±97.2	90.7±6.2	82.4±7.4
GA_3	10	16349±90.5	12949±80.5	94.0±7.7	78.0±7.1
	25	15270±90.4	13100±82.3	76.2±7.6	70.2±6.8
	50	13227±87.4	13800±83.6	65.4±7.4	60.5±6.7
	100	10049±71.5	14449±85.1	51.0±6.1	54.5±6.2
	200	10000±72.5	14700±86.2	50.0±7.2	53.1±8.2
	400	09981±80.2	14925±87.1	45.2±6.4	52.2±8.1
	800	9900±86.7	15000±86.1	44.6±6.8	51.6±7.8
Ethephon	10	27349±117.0	27399±117.1	175.0±9.9	184.0±10.2
	25	25280±116.0	25412±126.2	140.0±8.9	170.2±10.3
	50	21360±127.5	20320±135.4	135.0±9.2	150.6±9.4
	100	20412±120.2	19721±130.6	130.0±8.8	130.4±9.7
	200	19623±110.4	16220±120.7	125.0±7.9	115.0±9.8
	400	18850±97.2	12599±79.5	123.0±8.5	98.0±7.8
	800	18860±98.1	12602±80.5	122.2±8.3	97.0±7.0

Fourteen leafs from top
Eight leafs from top

to about 42.11% of that of control. On other hand photosynthetic efficiency of upper leaf of plants sprayed with 50 ppm GA_3 increased by about 43.6%. in comparison to that control.

Photosynthetic efficiency (expressed as cpn/ cm^2 leaf area) was found to be higher in lower leaf of upper leaf in all the treatment and 400 ppm in which no difference in photosynthetic efficiency of lower leaf in plant sprayed with ethrel (400ppm) decreased by about 35.16% of that of Control, while that of upper leaf of plants sprayed with GA_3 in (50 ppm) increased by about 61%.

At 55 days:

Data recorded after 3 weeks of spray on photosynthetic efficiency of lower (14th from top) and (8th from top) lower of plants given different treatments are present in Table 2.

Data for photosynthetic efficiency of upper and lower leaves of plants receiving various treatments show that lower concentration of cycocel and ethephon (10 and 50 ppm) increased photosynthetic efficiency of lower leaf by 55.4 and 52.3%, respectively. Higher concentration of GA_3 (100 ppm) decreased photosynthetic efficiency by 43.0%. Photosynthetic efficiency of upper leaf also increased by 95% with ethrel 50 ppm treatment. Data obtained for photosynthetic efficiency (Expressed as cps cm^{-2} leaf area) of lower of upper

Table 2: Effect of phytohormones sprays to 40 days old sunflower plants on photosynthetic efficiency of upper and lower leaves, recorded after three weeks of spray

Treatments Phytochormones	Conc. (ppm)	cpm gm^{-1} dry weight		cpm cm^{-1} leaf Area	
		Lower leaf	Upper leaf	Lower leaf	Upper leaf
(Control)	-	17100±92.4	12501±79.0	91.2±7.5	77.0±7.1
Cycocel	10	11799±77.0	11199±75.0	67.0±6.7	54.0±6.2
	25	13500±78.0	12230±80.0	78.2±6.2	65.2±7.0
	50	15330±80.0	12944±81.2	85.5±6.6	70.0±7.2
	100	16199±95.5	13099±81.0	90.0±7.5	73.0±6.9
	200	17220±93.6	14000±80.7	92.5±7.4	74.2±6.8
	400	18150±95.3	14570±81.6	91.2±7.2	75.4±6.7
	800	18770±95.4	14880±83.2	90.6±6.6	76.6±6.8
GA_3	10	14649±85.7	11899±77.1	87.0±7.4	69.0±6.8
	25	14530±86.6	11212±76.2	87.5±7.2	67.2±6.7
	50	14210±87.2	11050±75.1	88.0±7.3	64.3±6.5
	100	14149±84.0	10350±72.0	89.0±7.4	69.0±6.8
	200	14100±84.2	10212±70.0	89.5±8.0	58.6±6.2
	400	14010±83.7	10110±73.0	90.2±7.9	57.5±6.3
	800	14000±86.2	10000±71.0	92.6±7.8	56.2±6.2
Ethephon	10	18249±95.5	12224±78.3	85.0±7.2	69.0±6.7
	25	13012±96.4	12220±76.4	74.0±7.3	65.2±5.6
	50	12272±98.2	12210±77.2	70.0±7.2	63.4±6.2
	100	11077±97.4	12205±78.8	65.4±7.6	60.5±6.7
	200	10000±96.5	12175±76.3	60.6±6.2	55.6±7.2
	400	9899±70.5	12149±78.0	59.0±6.3	58.0±6.3
	800	9500±73.6	12120±77.5	58.6±6.2	58.2±6.1

Fourteen leafs from top
Eight leafs from top

leaf also show that ethephon (25 and 50 ppm) increased the photosynthetic efficiency of lower leaf of 14.5 and 90% respectively but it was decreased by GA_3 (100 ppm) treatment to the extent of 44.5% photosynthetic efficiency of upper leas increased by 152 and 34% with 50 and 500ppm, ethephon while 10 ppm GA_3 decreased it by 26 and 25.3%

The Decrease in photosynthetic efficiency by cycocel as observed here has also been reported in sunflower, oat and chickweed. It has been suggested that such inhibitory effects may be attributes to the higher concentrations of the hormones used while at 10^{-5} M (1.7s ppm) concentration cycocel increased photosynthetic Co_2 fixation by 2.7 folds in Avena chalcophiles, at 10^{-2} M (1750 ppm) concentration the co_2 fixation was markedly reduced by cycocel application.

Almost similar trend of effects was obtained when photosynthesis efficiency was expressed either on leaf area basis (14c count min^{-1}, cm^{-2}) or on dry weight bases (14c counts min^{-1}, mg dry wt.). Most of the treatments except cycocal (50 ppm) and GA_3 (10 ppm) decreased photosynthetic 14 Co_2 fixation when applied to 10 day old plants. The maximum reduction was caused by ethrel treatments. When applied to 40 or 55-days old plants, most of the hormonal sprays had slightly inhibitory effect. However, ethrel spray (50 ppm) at 55-days caused marked increased in photosynthetic efficiency of both bottom and top leaves. The photosynthetic basis for increasing yield in values maximizing.

1. The amount of light intercepted by the foliage.
2. Photosynthetic efficiency (III) the partitioning of photosynthate to the harvested economic sink (Gifford et al., 1984).

References

Adesh, K. and Bhatnagar, V. K. (2019). Effect of Phytohormones on the Morphological Parameters on 40, 55 and 70 Days in Sunflower (Helianthus Annuus L.). The Journal of Rural and Agricultural Research Vol.19 No. 1, 49-53 (2019).

Adesh, K. and Bhatnagar, V.K. (2013). Studies on the effect of Phytohormones on the Morphological Biochemical Parameters in Sunflower (*Helianthus Annus L.)* Ph. D. Thesis Rohilkhan Unive., Bareilly.

Constable, G.A. (1995). Predicting yield responses of cotton to growth regulations. Proceedings of the world cotton Research Conference on challenging the future Vol, Brisbane, Australia, (CSIRO Melbourne).

Edmisten, K.L. (1995). The use of plant monitoring techniques as aid in me piquest chloride rates determining me piquest in rain-fed cotton. Cottro Procedings of the world Research Conference on challenging the futures, Val.l, Brisbane, Australia, (Csiro Melbourne).

Fagoria NK (1992). Maximizing Crop Yields. (Marcel Dekker, New York).

Jung, J. (1964). Experimental results on the action of cycocel in wheat, ccc Research Symposium, Geneva, pp. 43-71.

Khalil, A. and Rahman, H. (1995). Effect of paclobutrazal on growth, chloroplast pigments and sterol biosynthesis of maize (Zea Mays L.). Plant Science 105, 15-21.

Kerby, T.A. (1985). Cotton response to mepiquat chloride. Agronomy Journal 77, 907-912.

Kust, C.A. (1985). Cycorel plant growth regulant: grains: uses in small grains. Cyanamid Cocument."

Sanvicente' P.; Lazarevitch, S.; Blouet, A. and Gucker, A. (1999). Morphological & anatomical modifications in winter barley culm after plant growth regulatory treatment, European Journal of Agronomy II 45-51.