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**RS Bochalya**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Deepak Kumar**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Raj Singh Choudhary**
Division of Soil Science and Agricultural Chemistry, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Monika Menia**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Swati Mehta**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Meenakshi Attri**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Shubham Jamwal**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Shesh Narayan Kumawat**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

**Corresponding Author:**
**RS Bochalya**
Division of Agronomy, SKUAST-J Chatha, UT of Jammu and Kashmir, India

# Effect of foliar nutrients and growth regulator on the growth and relative economics of spring hybrid sunflower (*Helianthus annuus* L. Var. GKSF-2002) under gangetic alluvial soils of West Bengal

**RS Bochalya, Deepak Kumar, Raj Singh Choudhary, Monika Menia, Swati Mehta, Meenakshi Attri, Shubham Jamwal, Shesh Narayan Kumawat and Rakesh Kumar Choudhary**

**Abstract**
A field experiment was conducted during the spring season of 2017 at the Agricultural Experimental Farm Baruipur of Institute of Agricultural Science of Calcutta University, located in the Gangetic region of West Bengal, India for making a reasonable assessment to study the effect of foliar nutrients and growth regulator on the growth and relative economics of spring hybrid Sunflower (*Helianthus annuus* L. Var. GKSF-2002). A total of six foliar nutrients, including Water spray ($T_1$), KCl@ 0.5% ($T_2$), $KNO_3$ @ 0.5% ($T_3$), DAP @1.5% ($T_4$), N P K 10:26:26 @1.5% ($T_5$) and NaCl @0.25% + Turmeric @ 0.25% ($T_6$) and four levels of growth regulator including Cycocel @ 0.2% ($T_7$), Cycocel @0.25% ($T_8$), Cycocel @ 0.3% ($T_9$) and Cycocel @ 0.25% + N P K 10:26:26 @1.5% ($T_{10}$) were established. The treatments were arranged in a randomized block design with three replications.
The stem girth (cm), dry matter accumulation per plant and crop growth rate (g/plant) were superior in $T_{10}$, $T_5$ and $T_8$ compared to $T_1$, $T_2$, $T_3$, $T_4$, $T_6$, $T_7$ and $T_9$. According to the results for the growth, the order was $T_{10}>T_5>T_8>T_4$ respectively. The results showed that using a foliar application of Cycocel @ 0.25% + N P K 10:26:26 @1.5% increased the growth of sunflower significantly, as compared to the other treatments. Higher cost of cultivation per hectare was recorded with the treatment of $T_3$ followed by treatments of $T_9$ and $T_8$. Lowest cost of cultivation per hectare was obtained by treatment $T_1$. Higher gross returns per hectare was recorded with the treatment $T_{10}$ followed by treatments of $T_5$, $T_4$ and $T_8$. Higher net returns per hectare was recorded with the treatment $T_5$, $T_{10}$ and these treatments are significantly superior over $T_7$. The higher BC ratio (3.31) was recorded with $T_5$ followed by (3.04) with foliar spray of $T_4$ and (2.90) with the treatment $T_6$ (NaCl @0.25% + Turmeric @ 0.25%).

**Keywords:** Sunflower, foliar nutrients, growth regulator, cycocel

## Introduction
Sunflower (*Helianthus annuus* L.) is one of the most edible oilseed belong to Asteraceae family. It is a substantial oilseed crop came after soybean and peanut accompanied by other oil seed crops like (canola and cotton), which participates significantly to edible oil all over world (Thavaprakash *et al*., 2002) [12]. This crop occupies over 22.81 million hectares in the world, with a global production accounted to about 60.5million tons. (FAO, 2019) in India, total sunflower seed production is about 0.24 mt 2018-19 with a sizable oil production of 0.068 mt, whereas projected demand of 0.77 mt and 0.40 mt for seed production and oil yield respectively in 2024-25. Furthermore, the per capita edible oil consumption rise from 19.3 to 23.20 kg/person/annum during the corresponding period will escalate the edible oil requirement from 25.74 to 33.38 mt in 2025 (Vishnuvardhan *et al*., 2020) [13].
Now a days, the consumption of edible oil is increasing, whereas production is declining due to the imbalanced application of nutrients in India. The increased demand for food grain production has led to intensive cultivation which indicates that there is great scope in improving the productivity potential by using suitable measures particularly, the use of plant growth regulators and foliar nutrients. Plant growth regulators so far have emerged as "magic chemicals" that could increase agricultural production at an unprecedented rate and help in removing and circumventing many of the barriers imposed by genetics and environment. Plant growth regulators (promoters, inhibitors or retardants) play key role in contributing internal mechanisms of plant growth by interacting with key metabolic processes such as, nucleic acid

metabolism and protein synthesis. Growth retardants are known to reduce inter-nodal distance, thereby enhancing source-sink relationship and stimulate the translocation of photo-assimilates to the seeds (Luib *et al.,* 1987) [5]. Growth regulators exert their influence on foliar transport in a number of ways. These could enhance the absorption by the leaf at the site of application, increase the migration within the leaf and/or stimulate the transport out of leaf in the acropetal and basipetal direction. For increasing seed yield and quality in sunflower, several approaches like application of micro nutrients, plant growth regulators, and protection against moisture stress has been suggested by Nanja Reddy *et al.* (2003) [7].

They noticed that foliar application of nutrients with application of growth regulators to the plant improved the translocation of photosynthates to the head and increased seed yield. Prasad and Sastry (1978) [7] reported that exogenous application of growth regulators to the developing head was shown to increase the transport of photosynthates from leaf to the developing head. However, Pankaj Kumar *et al*. (2006) [8] reported that growth retardants *viz*., TIBA, Cycocel and mepiquat chloride were more beneficial in terms of the translocation of photo-assimilates towards developing reproductive parts compared to growth promoter kinetin and the control. Plant growth regulators are known to change the growth and development pattern of crop plants by altering many physiological and biochemical processes and thereby increasing the yield of crops. Fertilizers are energy intensive to produce and are very expensive. The application of these nutrients through foliar fertilization is a prominent one due to rapid translocation of these nutrients to leaf and seed is superior to soil application (Abdul Aziz *et al*., 2016) [1]. Foliar nutrients usually penetrate the leaf cuticle or stomata and enter the cells facilitating the easy entry of nutrients. Hence an attempt was made to study the effect of micronutrients through foliar application along with primary and secondary nutrients on the growth of sunflower.

## Materials and Methods

The field experiment entitled "Effect of foliar nutrients and growth regulator on the growth, yield parameters and relative economics of spring hybrid Sunflower (*Helianthus annuu*s L. Var. GKSF-2002) under Gangetic alluvial soils of West Bengal" was conducted during spring season of 2017 for making a comparative assessment of foliar nutrient and growth regulator management of sunflower on the productivity in Gangetic plains. Kolkata is situated at 22°53`N latitude and 88° 26`E longitude at an altitude of about 6.4 m above mean sea level. It has a semi-arid and sub-tropical climate with hot humid summers and cold winters. The mean maximum temperature in June, which is the hottest month of the year, ranges from 40° to 45 °C, while the mean minimum temperature in the coldest month of January is as low as 12.9 °C. The mean annual rainfall is about 1582 mm, of which nearly 80 per cent is received during the monsoon period from June to September and the rest during the period between October and May. The mean wind velocity varies from 11 km $hr^{-1}$ during October to 15 km $hr^{-1}$ during April. Mean relative humidity attains the maximum value (85 to 90% or even more) during the south-west monsoon and the minimum (30 to 45%) during the summer months. The soil of Agricultural Experimental Farm, Baruipur belongs to order Inceptisol, Mahauli series having clayey texture in upper 15 cm layer. Water table remained below 3.5 m deep from ground surface during crop growth period. A composite representative soil sample was collected from the experimental field prior to experimentation and analyzed. The soil was sandy loam in texture, poor in organic carbon (0.76%), available N (174.3 kg/ha) and medium in available P (29.7 kg/ha). Foliar spray: At 50% flowering stage and seed filling stage Treatment details $T_1$: Water spray, $T_2$: KCl @ 0.5%, $T_3$: $KNO_3$ @ 0.5%, $T_4$: DAP @1.5%, $T_5$: N P K 10:26:26 @1.5%, $T_6$: NaCl @ 0.25% + Turmeric @ 0.25%, $T_7$: Cycocel @0.2%, $T_8$: Cycocel @ 0.25%, $T_9$: Cycocel @ 0.3% and $T_{10}$: Cycocel @ 0.25% + N P K 10:26:26 @ 1.5%.

### Recommended dose of fertilizers

N: $P_2O_5$: $K_2O$=80:100:100 kg/ha after harvest of *Kharif* rice, the land was given preparatory tillage once at optimum moisture condition. Finally, the land was prepared by giving two cross ploughings by power tiller followed by planking when the experimental field brought into appropriate tilth, the field was laid out in a randomized block design with three replications. All the treatments were allotted at random to each plot under each replication and there were as many plots as the number of treatments.

### Variety

GKSF-2002- This variety is a medium tall, early maturing (100-120 days) and robust plant type with excellent uniformity of plant height and heads. Capitulum is fully convex, mono head, uniformly big size. Leaves are big dark green. Complete filling, light brown and bold seed and high yielding. It has large head diameter and bold seeds with yield potential up to 2500 kg/ha. Seed Sowing: The sowing of spring sunflower was done by dibbling method with row to row spacing of 60 cm and plant to plant spacing of 30 cm with the seed rate used was 4 kg/ha.

### Thinning and gap filling

Extra plants in the rows were thinned to maintain a plant to plant spacing of 30 cm on 15th day after sowing. The filling of gaps was also accomplished immediately after the completion of germination in order to maintain optimum plant population. Intercultural operations: The weeds were controlled by two hand weeding with the interval of 15 days in Sunflower.

### Irrigation

Four irrigations, i.e., one each as germination, budding, flowering and seed filling stages were given to the crop. Plant protection measures: Spray of Metasystox @ 0.5% for control of leaf eating caterpillar in sunflower after 45 DAS was done.

### Harvesting and Threshing

The net plots of sunflower were harvested on the maturity separately and dried before recording the biomass yield**.**

### Statistical analysis

The experimental data were statistically analyzed, as suggested by Gomez and Gomez (1976) [3]. For significant results, the critical difference was worked out at 5 per cent level.

## Result and Discussion

### Influence of foliar nutrients and growth regulator on stem girth (cm) at different growth stages in sunflower

The data on stem girth predisposed by foliar nutrients and

growth regulator on spring hybrid sunflower at various growth stages of sunflower have been presented in Table 1. Stem girth did not vary at 30 and 60 DAS but treatments differed significantly at 90 DAS. At 90 DAS, the maximum stem girth (8.26 cm) was recorded in N P K 10:26:26 @1.5% which was on at par with NaCl @ 0.25% + Turmeric @0.25% and DAP @1.5% Within the foliar application of different doses of plant growth retardant (Cycocel), the maximum stem girth (cm) was observed in Cycocel @ 0.25% followed by Cycocel @ 0.2%). The minimum stem girth (cm) was observed in case of Cycocel @ 0.3%. This could be due to the translocation of stored photo-assimilates towards the development of reproductive organs. This type of growth behaviour in stem girth (cm) has also been reported by Kumar and Yadav (2007) [4].

**Table 1:** Influence of foliar nutrients and growth regulator on stem girth (cm) at different growth stages in sunflower

| Treatments | Stem Girth (cm) | | |
|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS |
| $T_1$: Control | 2.30 | 5.73 | 6.96 |
| $T_2$: KCl@ 0.5% | 2.50 | 5.91 | 7.53 |
| $T_3$: KNO3 @ 0.5% | 2.43 | 5.92 | 7.56 |
| $T_4$: DAP @1.5% | 2.46 | 6.03 | 8.03 |
| $T_5$: N P K 10:26:26 @1.5% | 2.46 | 5.93 | 8.26 |
| $T_6$: NaCl @0.25% + Turmeric @0.25% | 2.46 | 5.93 | 8.06 |
| $T_7$: Cycocel @0.2% | 2.40 | 5.93 | 6.53 |
| $T_8$: Cycocel @0.25% | 2.50 | 5.76 | 6.63 |
| $T_9$: Cycocel @0.3% | 2.63 | 5.86 | 6.40 |
| $T_{10}$: Cycocel @0.25% + N P K 10:26:26 @1.5% | 2.46 | 5.90 | 7.10 |
| CD (P=0.05) | NS | NS | 0.41 |

**Influence of foliar nutrients and growth regulator dry matter production (g /plant) at different stages in sunflower**

The data on dry matter production (g/plant) as partisan by foliar nutrients and growth regulator on spring hybrid sunflower at various growth stages of sunflower have been presented in Table 2. Dry matter production (g/plant) did not vary at 30 and 60 DAS but treatments differed significantly at 90 DAS. At 90 DAS, the maximum dry matter production (136.10 g) was recorded in N P K 10:26: 26 @1.5% which was closely followed by NaCl @ 0.25% + Turmeric @ 0.25% (133.48 g) however; minimum dry matter production was recorded in control treatment. Within the foliar application of different doses of plant growth retardant (Cycocel), the maximum dry matter production (g/plant) was observed in Cycocel @0.25% followed by Cycocel @0.2%). The minimum was observed in case of Cycocel @0.3%. The probable reason of highest dry matter production attributing characters may be due to the foliar application of two/three salts met the N-P-K requirement of the crop during flowering periods resulting in greater availability, absorption of nutrient and efficient translocation of assimilates to reproductive parts which eventually contribute to the high yield attributes. These results are in line with the findings of Reddy *et al*. (2005) [9]. They also reported that improved nutritional management as a result of foliar nutrients were found to increase nutrients supply might have favorable effect led to increase transformation of photosynthesis. Similar results were also obtained by Sarkar *et al*. (2007) [11] and Mallick and Sarkar (2009) [6] in sunflower.

**Table 2:** Influence of foliar nutrients and growth regulator on dry matter production (g/plant) at different growth stages in sunflower

| Treatments | Dry matter production (g/plant) | | |
|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS |
| $T_1$: Control | 6.14 | 80.65 | 120.70 |
| $T_2$: KCl@ 0.5% | 6.07 | 85.52 | 128.64 |
| $T_3$: KNO3 @ 0.5% | 5.93 | 85.74 | 129.20 |
| $T_4$: DAP @1.5% | 5.86 | 84.91 | 130.93 |
| $T_5$: N P K 10:26:26 @1.5% | 5.88 | 93.05 | 136.10 |
| $T_6$: NaCl @0.25% + Turmeric @0.25% | 5.92 | 85.84 | 133.48 |
| $T_7$: Cycocel @0.2% | 5.78 | 88.62 | 112.81 |
| $T_8$: Cycocel @0.25% | 5.92 | 85.81 | 115.37 |
| $T_9$: Cycocel @0.3% | 6.05 | 82.33 | 112.67 |
| $T_{10}$: Cycocel @0.25% + N P K 10:26:26 @1.5% | 5.87 | 86.56 | 121.68 |
| CD (P=0.05) | NS | NS | 7.50 |

**Influence of foliar nutrients and growth regulator on crop growth rate (g/m/ day) at different growth stages in sunflower**

The data on CGR (g) subjective by foliar nutrients and growth regulator on spring hybrid sunflower at various growth stages of sunflower have been presented in Table 3. CGR (g) did not vary at 30 and 60 DAS but it differed significantly at 60-90 DAS. At 60- 90 DAS, the maximum CGR (1.63 g) was recorded in N P K 10:26:26@1.5% and Cycocel @ 0.25% + N P K 10:26:26 @ 1.5%. However, minimum CGR was recorded with 0.81. It may be by applying a foliar fertilizer directly to the leaf, it increases the activity in the leaf, at the same time increasing chlorophyll and thus photosynthesis. Because of this increased activity, it increases the need for water by the leaf. In turn this increases water uptake by the plants vascular system, which in turn increases the uptake of nutrients from the soil. The essential role of chlorine lies in its biochemical inertness, which enables it to fill osmotic and cation neutralization roles which have biochemical and/or biophysical consequence of importance. Also, Chlorine

increases the efficiency of chloroplast, provides oxygen in photosystem-II in the process of photosynthesis. It thus, regulates osmotic pressure, turgor pressure, plant-water potential, osmotic potential, which facilitates the water availability to plants. The foliar application of N-P-K requirement of the crop with fertilizers and growth retardants during flowering periods resulted in greater availability, absorption of nutrient and efficient translocation of assimilates to reproductive parts which eventually contribute to the high yield attributes. These results are in line with the findings of Reddy *et al*. (2005) [9] and Sakal *et al*. (1991) [10].

**Table 3:** Influence of foliar nutrients and growth regulator on crop growth rate (g/m/ day) at different growth stages in sunflower

| Treatments | CGR (g) | |
|---|---|---|
| | 30-60 DAS | 60-90 DAS |
| $T_1$: Control | 2.48 | 1.33 |
| $T_2$: KCl@ 0.5% | 2.64 | 1.43 |
| $T_3$: KNO3 @ 0.5% | 2.66 | 1.56 |
| $T_4$: DAP @1.5% | 2.63 | 1.53 |
| $T_5$: N P K 10:26:26 @1.5% | 2.9 | 1.63 |
| $T_6$: NaCl @0.25% + Turmeric @0.25% | 2.66 | 1.60 |
| $T_7$: Cycocel @0.2% | 2.76 | 0.81 |
| $T_8$: Cycocel @0.25% | 2.66 | 0.99 |
| $T_9$: Cycocel @0.3% | 2.54 | 1.00 |
| $T_{10}$: Cycocel @0.25% + N P K 10:26:26 @1.5% | 2.67 | 1.63 |
| CD (P=0.05) | NS | 0.37 |

**Table 4:** Economics of sunflower as influenced by different foliar nutrient and growth regulator

| Treatments | Cost of cultivation (Rs./ha) | Gross return (Rs./ha) | Net return (Rs./ha | Benefit: cost ratio |
|---|---|---|---|---|
| $T_1$: Control | 18902 | 55800 | 36898 | 1.95 |
| $T_2$: KCl@ 0.5% | 22527 | 68100 | 45573 | 2.02 |
| $T_3$: KNO3 @ 0.5% | 25402 | 71100 | 45698 | 1.80 |
| $T_4$: DAP @1.5% | 19465 | 78600 | 59135 | 3.04 |
| $T_5$: N P K 10:26:26 @1.5% | 19371 | 83400 | 64029 | 3.31 |
| $T_6$: NaCl @0.25% + Turmeric @0.25% | 19400 | 75600 | 56200 | 2.90 |
| $T_7$: Cycocel @0.2% | 23152 | 72900 | 49748 | 2.15 |
| $T_8$: Cycocel @0.25% | 24002 | 78000 | 53998 | 2.24 |
| $T_9$: Cycocel @0.3% | 25277 | 50400 | 25123 | 0.99 |
| $T_{10}$: Cycocel @0.25% + N P K 10:26:26 @1.5% | 24471 | 85200 | 60729 | 2.48 |

**Economics of sunflower as influenced by different practices**

**Cost of cultivation (Rs./ha)**

The data pertaining to the cost of cultivation incurred in sunflower production as influenced by different nutrient management practices are furnished in Table 4. Higher cost of cultivation per hectare (Rs. 25402/ha) was recorded with the treatment of $T_3$ (Foliar spray of $KNO_3$ @ 0.5%) followed by treatments of $T_9$ (Foliar spray of Cycocel @ 0.3%) per hectare (Rs. 25277/ ha), $T_8$ (Foliar spray of Cycocel @ 0.25%) per hectare (Rs. 24002/ ha). Lowest cost of cultivation per hectare (Rs. 18902/ha) was obtained by treatment $T_1$ (water spray).

**Gross returns (Rs./ha)**

The data pertaining to the gross returns of sunflower as influenced by different nutrient management practices are furnished in Table 4. Higher gross returns per hectare (Rs. 85200/ha) was recorded with the treatment $T_{10}$ (Foliar spray of Cycocel @0.25% + N P K 10:26:26 @1.5%) followed by treatments of $T_5$ (Foliar spray of N P K 10:26:26 @1.5%) per hectare (Rs. 83400/ ha), $T_4$ (Foliar spray of DAP @1.5%) per hectare (Rs. 78600/ ha) and $T_8$ (Foliar spray of Cycocel @ 0.25%) per hectare (Rs. 78000/ ha).

**Net returns (Rs./ ha)**

The data pertaining to the net returns of sunflower as influenced by different nutrient management practices are furnished in Table 4. Higher net returns per hectare (Rs. 64029 /ha) was recorded with the treatment $T_5$ (Foliar spray of NPK 10:26:26 @ 1.5% and (Rs. 60729/ ha) with the treatment of $T_{10}$ (Foliar spray of Cycocel @ 0.25% + N P K 10:26:26 @1.5%) and these treatments are significantly superior over $T_7$ (DAP @1.5%) (Rs. 59135/ ha).

**Benefit Cost Ratio**

The data pertaining to the benefit cost ratio of sunflower as influenced by different nutrient management practices are furnished in Table 4. The higher BC ratio (3.31) was recorded with $T_5$ (Foliar spray of NPK 10:26:26 @ 1.5%) followed by (3.04) with foliar spray of $T_4$ (DAP @1.5%) and (2.90) with the treatment $T_6$ (NaCl @0.25% + Turmeric @0.25%).

**Conclusion**

Among all the foliar treatments, $T_{10}$ (Cycocel @ 0.25% + N P K 10:26:26 @1.5%) recorded the highest growth (stem girth, Dry matter production and CGR) followed by $T_5$ (N P K 10:26:26 @1.5%), $T_4$ (DAP @1.5%) and $T_8$ (Cycocel @0.25%). It is worth to note that even spraying of NaCl @ 0.25% + Turmeric @0.25% ($T_6$) significantly improved all the growth of this crop. The increase in the growth could also be attributed higher stem girth, dry matter production and CGR area of green leaves. All these parameters showed a significant difference as compared to water sprayed treatment. The application of N P K 10:26:26 @ 1.5% was found to be most cost effective foliar nutrient. DAP @1.5% was found to be second most cost effective foliar nutrient. These two supplementary foliar nutrient treatments were found to be significantly at par. It is very interesting to note that though N

P K 10:26:26 and DAP are the soil grade fertilizers which are easily available at the doorstep of farmers have also given more growth of sunflower when they applied as foliar nutrients.

**References**


1. Abdul Aziz Khan Bariach, Allah Wadhayo Gandhi, Shamsuddin Tunio, Qamaruddin Chachar. Influence of micronutrients and their method of application on yield and yield components of sunflower. Pak. J Bot. 2016;48(5):1925-1932
2. FAO. FAOSTAT, http://www.fao.org/faostat/en/ #home. 2019.
3. Gomez AA and Gomez RA. Statistical procedure for Agricultural research with emphasis on rice. IRRI. Los Banos Philippines. 1976.
4. Kumar H and Yadav DS. Effect of phosphorus and sulphur on growth, yield and quality of mustard (*Brassica juncea*) cultivars. Indian Journal of Agronomy. 2007; 52(2):154-157.
5. Luib M, Koehle H, Hoeppner P. and Rademacher W. Further results with BAS11104W, a new growth regulator for use in oilseeds rape. In: Plant Growth Regulators for Agricultural and Amenity Use. Ed. Hawkins, A. F., Stead, A. D. and Pinfield, N. J., BCPC Publications, Monograph. 1987;36:37-43.
6. Mallick RB and Sarkar RK. Effect of planting geometry and nitrogen fertilization on productivity and economic feasibility of sunflower (*Helianthus annuus* L.) and greengram (*Vigna radiata* L.) intercropping system in rice fallow gangetic alluvial land. Indian Agriculturist. 2009 53(1 & 2):13-19.
7. Nanja Reddy YA, Uma Shankar R, Prasad TG and Udaya Kumar M. Physiological approaches to improving harvest index and productivity in sunflower. Helia. 2003;26(38):81-90.
8. Pankaj Kumar, Hiremath SM and Chetti MB. Influence of growth regulators on dry matter production and distribution and shelling percentage in determinate and semi-determinate soybean genotype. Legume Res. 2006;29(3):191-195.
9. Reddy PM, Reddiramu Y and Ramakrishna Y. Conjunctive use of biological, organic and inorganic fertilizers in Sunflower *Helianthus annuus* L. Journal of Oil seed Research. 2005;22(1):59-62.
10. Sakal R, Singh AP, Sinha RB, and Bhogal NS. Relative susceptibility of some important varieties of sesamum and mustard to boron deficiency in calcareous soil. Fertiliser News. 1991;36(3):43-46.
11. Sarkar RK, Deb N, and Parya MK. Effect of seed treatment and foliar nutrition on growth and productivity of spring sunflower (*Helianthus annuus*). Indian Journal of Agricultural Sciences. 2007;77(3):191-194.
12. Thavaprakash NSD, Siva-Kumar K, Raja and G Senthil-Kumar. Effect of nitrogen and phosphorus levels and ratios on seed yield and nutrient uptake of sunflower hybrid Dsh-I. Helia. 2002;25:59-68.
13. Vishnuvardhan Reddy A, Sudhakara Babu SN, Radhakrishnan T, Bhatia VS and Rai PK. Status and technological options for increasing oilseeds production. National seminar on Technological innovations in oilseeds crops for enhancing productivity, profitability and nutritional security, ISOR, Hyderabad. 2020.