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Comparative study of tria on oil-seed crop in relation to growth and yield

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Abstract
In this paper Oil seed crops occupy an important place in agricultural economy of India constituting the main commercial crops and the second agricultural crops to the food grains in acreage, tonnage and value. There are about nine important cultivated oil-seed crops, out of which safflower, sesame and mustard forming important group. Oil seed provide vegetable oil which is not only the essential part of human diet but also serves as an important raw material for various industrial products. Indian oilseed's yield are around half of the world average and almost one-third that of the leading producers in the world. Besides this oil seeds constitute a significant place in India's national economy contributing about 6% of the national income and their products earn valuable foreign exchange for the country. The cultivation of oil seeds provides employment to about 14.5 Million persons in different activities of marketing and processing.

Keywords: oil-seed, yield, industrial products

Introduction
Oil seeds are the main soure of vegetable fat as well as cheap and rich source of protein in predominantly vegetarian diet of people all over the world (Singh and Singh, 2001). Per capita availability of fats and oils has slided down recently. The availability is only 1/5th of the optimum nutritional standard of 16 kg per capita per annum advocated by the food and agriculture organisation of the United Nation. The developed countries viz. U.K. and Germany consume 14.0 and 25.1 kg of vegetable oil per head per annum, respectively.

The vegetable oil not only forms the essential part of human diet but also serve as an important raw material for the agro based industries and the manufacture of various other sophisticated products. Another important product obtained from oil seeds is oil cake which is used for livestock feeding on one hand and used as manure in the farming on the other (Singh and Singh, 2001).

All oils contain smaller proportions of free fatty acids and unsaponifiable matters including sterols, fatty alcohols, hydrocarbons and colouring matters. Dissolved impurities derived from the parent material are also present. Oil and fats are the triglycerides of fatty acids in which one molecule of glycerol combines with three molecules of fatty acids with the elimination of water. An oil is a liquid at the ordinary temperature.

In the recent years, as much attention has been diverted by the planners to increase the production of oilseed crops which has already been included under the Prime Minister's Twenty Point Programme. The production of oilseed crops is low in India. There is an increasing demand of oil seed crops. So, the productivity of oil seed has to be increased.

India is one of the four major players in the vegetable oil scenario of the world, being one of the important oilseed grower, producer, importer and exporter. There was five times increase in oilseed production during the period 1950-2004 under predominantly rain fed agro ecological conditions which is higher than even the corresponding production increases in total food grains. The best ever oilseed production of 25.1 million tonnes in the country was achieved during 2003-2004, which is still lower by about 14 million tonnes required to achieve the self-sufficiency.

The growth responses of TRIA treated plant in relation to number, area, thickness and weights, etc. were also altered with alternation in doses. Reis and Wert (1977) [1] have reported significant increase in leaf area of Rice cv. IR-8 with 8 hours of TRIA (2.3 x 10-8M) application, the increasing order was top leaf > middle leaf (9th) > the oldest leaf (5th). Similar trends in relation to leaf growth were obtained by Debata and Murty (1981) [2] in oil seed plants.

Incidentally increase in leaf area and weight resulting from TRIA seems to be reflection of elevation in photosynthesis rate. Miniraj and Shanumgavellu (1987) [3] have also obtained more number of leaves in chillies cv. K2 due to TRIA spray at 1-2 ppm. increased number of leaves may be due to delayed senescence of leaves and increased uptake and mobilization of nutrients. Similar result have been obtained in banana cv. Poovan due to soil application of TRIA and groundnut cv. GG2 due to 200 ml/ha. TRIA reported that number of leaves per shoot was increased successively with increased concentrations of mixtalol (TRIA) from 0 ppm-4 ppm, beyond which it was reduce slightly in phalsa (*Grewia asiatica* L.). This increase in shoot length and number of leaves per shoot might be due to increased water uptake which is very crucial for cell turgor leading cell elongation and increased mitotic activity induced directly or indirectly through changes in auxin/cytokine in ratio due to mixtalol application. Bhattacharya and Rao (1996) [4] have also noted an increase in number and weight of leaves in rose-scented Geranium. Medhi (2000) [5] reported that higher number of leaves were maintained upto maturity by the growth regulating long chain aliphatic alcohol (TRIA) of 5 ppm than at 10 ppm. The leaf area index steadily increased upto 50 DAS and dropped thereafter. Leaf area was also higher than the control in case of French bean. TRIA application (0.5 ml/L) on betelvine showed highest leaf yield than the control (Arulmozhiyan, 2001) [6]. Srivasatva, *et al.* (2003) and Raghava, *et al.* (2005) [8, 9] reported similar trends in relation to growth.

In relation to reproductive growth, development and yield parameters, the efficacy of TRIA in herbaceous and woody plants vary considerably upon plant species, rate and timing of application. It showed beneficial responses on flowering, fruiting, pudding and seed yield. Seed yield per plant and number of seeds per silique of Mixtalol Treated mustard plants significantly increased but increase in 100 seed weight was not significant. The increase in fruit yield per bush of Mixtalol treated Phalsa (Grewia asiatica) was due to increase in the size and weight per fruit under the influence of. The number of seed per pod and seed weight were increased over control in Mixtalol treated rape plants as well as the seed yield was also increased significantly by 70.8% (Zau and Xi, 1993) [10]. TRIA treated rice plants showed enhancement of the grain weight after heading and the 1000 grain weight in brown rice as wel as percentage of ripened grains at harvesting time. Puste (1997) [10] has observed significant variations in respect to yield characteristics like capitullum/ plant, seeds/ capitullum and weight of 100 seeds of safflower treated with paras (Mixtalol).

Ver. name sarson; Family-Brassicaceae (Cruciferae) Mustard is a very fast growing oilseed crop of rabi. In our country mustard is chiefly grown for oil purpose. The seeds are commercially important because about 13% of edible oil comes from Brassica which has long chain fatty acids like eicosenoic acid and erucic acid. The mustard oil comprises triglycerols (95-98%) and a number of lipids, including unsoaponifiable hydrocarbons, terpenes, sterols, tocopherol and phospholipids. The important characteristic of the mustard oil is the presence of erucic acids (66%), linoleic acid and polyunsaturated linolenic acid (25%), unsaponifiable oleic acid (20%), palmitic acid and stearic acid 5%. The defatted meal contains about 40% protein, mineral and vitamins. This crop gives maximum production in loamy and sandy soils. It is cosmopolitan in distribution but the major centres of distribution are North temperate regions, especially the mediterranean region. The oil content is 30-45% which is extracted either by milling or by solvents. Amongst oil seed crops grown in India, Brassica ranks second in acreage with safflower grows on a wide range of soil but does best on a soil neutral in reaction, with a deep, well drained profile about 6.5 million ha, superseded by groundnut only with 7.5 million ha out of a total world production of 34 million tonnes in 1995.

Mustard oil is used primarily for cooking but also for making vegetable ghee, condiments and medicinal purposes in remedy for stomach and skin diseases, elephantiasis. Its oil cake is used as cattle feed and manure. Tender leaves and shoots are used as vegetable and given in food poisoning. It is an important ingredient in Indian cookry and is also used for lighting purposes and preserving various pickles and condiments. Medicinally, used in dengu fever, muscular rheumatism, stiff neck and in bronchitis etc. The husk of oil seeds after the extraction of oil is used in the form of cakes for cattle and crushed leaves are applied on head in headache.

Ver. name Kusum; family Asteraceae (Compositae). It is a minor oil seed crop in India. The plants have been cultivated for centuries in our country either for its orange red dye (carthamun) or for its much valued oil. The crop is now grown mainly for edible oil obtained from the seeds. Traditional centres for cultivation are North and North Eastern parts of the country and is now mainly cultivated in the peninsular region. Safflower grows well in a wide range of soils but does best on soil neutral reaction, with a deep well drained profile and E.A. Weiss (1983) [12] reported that the crop tolerates high salinity. Important varieties are Manjira, NARI-6, Bhima, HUS -305, Nira (NRS -209) etc. India accounts for nearly 59 and 42% of world's safflower area and production respectively. Many new and improved cultivars have been released and the number is increasing rapidly as the popularity of crop grows.

Safflower produces oil, rich in poly unsaturated fatty acids (Linoleic acid 78%) which reduces blood cholesterol level. It is also used as cooking oil, margarine, mayonnaise and salad dressing. The oil is valued in preparation of paints, varnishes, surface coatings. Roghan oil is used for healing sores and in rheumatism. The oil is an effective non allergenic dispersant. Dried red and orange flowers are sold as substitute for saffron and used to colour foods and beverages. Flowers are also used in the preparation of cosmatics. Oil cake is generally used as manure and poultry feed. Hulls can be used in the manufacture of cellulose; insulations, abrarsins, hardboards and as fuel. Leaves have rich carotene, riboflavin and vitamin C, hence young plants are used as vegetable.

Ver. name Til or Tila, Family: Pedeliaceae. De Candolle considered as having come from Sunda islands or Archipilago. Others regard it from India or African origin. It is an important oil seed crop of India cultivated since ancient times. It is an annual erect herb and branched profusely from the base. Sesame is mainly a crop of the tropics and subtropics and normally found below 1, 250 m and optimum temperature range for growth and development is 27-33 °C it is a short day plant. In our country, mainly grown in U.P., Rajasthan, A.P. Tamilnadu and Maharastra, etc.

Sesame crop grown in India from ancient time, for oil and various purposes. About 78% of production is used for oil extraction and 20% for domestic use including preparation of sweets, candies, as condiments, culinery purposes confectionary and about 2-3% is retained for next sowing. Sesame is used as a nourshing food, as a flavouring agent and

for medicinal purposes. The hull accounts for 15-20% of the whole seed and contains 2-3% oxalic acid, 1-2% calcium and high in fiber. Sesame oil produced in India is mainly as edible oil. It is widely used in manufacture of soaps, cosmetics, perfumes, scented hair oils, insecticides and in pharmaceutical products. The oil is also used in the formulation of antacids, ointments and for injecting fat soluble substances.

Sesame cake or meal obtained as a byproduct of the oil milling industry is rich in protein, vitamins (Niacine) and minerals (Ca and P). The livestock feed valued as an ingredient of poultry feed.

Material and Method

The oil seed crops occupy an important place in agricultural economy in India, contributing about 6% of the national income and their products earn valuable foreign exchange for the country. There are about nine important cultivated oil seed crops commonly grown in India viz., groundnut, mustard, safflower, sesame, sunflower, castor, niger, linseed and cotton. Oil seeds are the main source of vegetable fats as well as cheap and rich source of protein in predominently vegetarian diet of people all over the world. The vegetable oil (drying and semidrying oil) not only form the essential part of human diet but also serves as an important raw material for industries and in manufacturing of various other products.

By virtue of their unique chemical composition made from glycerol and fatty acids, they offer a great scope in meeting the nutritional requirments of the population. Due to their potential and utility in human diet, a study was carried out to check their responses against application of Triacontanol (Natural PGR) on different morphophysiological and biochemical parameters.

Oil content in seeds was measured according to Soxhlet's extraction method. In which 5 gm. seeds were crushed with a pinch of $CaCO_3$ and this mixture was placed in Soxhlet's apparatus and was digested. In the digestion chamber of Soxhlet's appratus, sufficient amount of petroleum ether was placed in lower flask temperature was adjusted according to the boiling point of petroleum-ether. The apparatus was connected with a condenser. The oil was extracted at least for two or three hours then the flask was taken out. The material was dried in a heating chamber and amount of the oil was expressed as mg/g dry weight of tissue/seeds.

All the data collected on growth, productivity and biochemical attributes were subjected to statistical analysis of variance subjected to randomised black design as described by Panse and Sukhatme (1985).

Results & Discussion

The outcome got from the perception taken during the investigation of Miraculan on development, profitability and biochemical boundaries in three oil seed crops (Mustard, Safflower and Sesame) are created in the tables from 1-3 and figures 1-3.

Miraculan increase the shoot length with all the concentrations from 2 to 10 ppm. The gradual increase was noted from 35 to 65 DAS as compared to control. In case of mustard plants, the increase of shoot length was recorded from 1.29 to 34.96% over control. The maximum increase with 2ppm was recorded i.c. 34.96%, 25.88%, 18.37% at 35, 50 and 65 DAS, respectively as compared to control as shown Table-1.

Table 1: Effect of Triacontanol on the Shoot Length (cm) in different oil seed crops at different stages of growth (All the data are average of three replicates)

DAS / Conc. (ppm)	Mustard			Safflower			Sesame		
	35	50	65	35	50	65	35	50	65
Con.	42.76 ±0.37	63.28 ±0.14	80.43 ±0.35	26.12 ±0.14	41.67 ±0.14	72.86 ±0.02	34.67 ±0.14	43.66 ±0.03	76.6 ±0.22
2	65.53 ±0.40	85.11 ±0.45	98.78 ±1.12	32.33 ±0.55	47.33 ±0.15	84.27 ±1.12	40.33 ±0.18	48.12 ±0.04	85.2 ±0.36
4	60.83 ±0.12	80.35 ±0.39	91.38 ±1.31	30.67 ±0.31	45.67 ±0.34	80.15 ±0.55	38.33 ±3.5	46.00 ±0.12	84.0 ±1.35
6	55.14 ±0.29	69.50 ±0.12	88.26 ±0.55	28.33 ±0.24	44.00 ±0.12	76.63 ±0.35	37.00 ±0.22	45.67 ±0.03	82.0 ±0.33
8	50.18 ±0.23	65.78 ±0.03	84.06 ±0.09	27.67* ±0.16	42.00* ±0.31	73.25* ±0.22	36.33* ±0.15	44.33* ±1.12	80.33* ±0.37
10	43.28* ±0.31	64.00* ±0.40	81.75* ±0.02	26.25* ±0.09	41.85* ±0.06	72.96* ±0.12	35.15* ±0.16	43.82* ±0.35	78.33* ±0.25
C.D. at 5% level	**1.46**	**2.12**	**2.37**	**1.57**	**2.35**	**2.12**	**2.13**	**2.12**	**1.45**

DAS: Day after sowing, Conc.: Concentration,*: Non-Significant, Con. : Control

Overall, cumulative effect of two doses of Miraculan that is from preflowering to flowering shows greater increase as compared from flowering to post flowering. The increase in shoot length was still more with three cumulative doses of 8 and 10 ppm than that of the control.

In case of safflower, the increase in shoot length recorded with all the concentrations, from 2-10 ppm (overall 0.14 to 19.20%) as compared to control. All the concentrations except 8 and 10 ppm showed a significant increase in shoot length. The optimum increase was observed with 2 ppm i.e. 19.20%, 11.95% and 13.35% at 35, 50 and 65 DAS, respectively as shown Table-1. Initially at preflowering stage (35 DAS) Miraculan 2, 4 and 6 ppm was more effective as compared to 50 and 65 DAS.

The data recorded for root length showed higher increase from vegetative to flowering than flowering to post flowering. In case of mustard plants, 2 ppm was the most effective dose, from 35 to 65 DAS with 3 doses. The cumulative effect was higher with 2, 4, and 6 ppm than control. 10ppm of miraculan showed non-significant change at all the observations in mustard as shown in Table-2.

Table 2: Effect of Triacontanol on the Root Length (cm) in different oil seed crops at different stages of growth (All the data are average of three replicates)

DAS / Conc. (ppm)	Mustard			Safflower			Sesame		
	35	50	65	35	50	65	35	50	65
Con.	7.53 ±0.12	13.00 ±0.31	16.12 ±0.04	16.33 ±0.41	19.40 ±1.23	23.42 ±0.11	9.33 ±0.01	16.50 ±0.33	21.00 ±1.13
2	10.70 ±0.02	16.26 ±0.21	20.16 ±1.11	19.44 ±0.23	23.27 ±0.35	30.72 ±0.03	12.23 ±0.33	21.24 ±0.26	27.25 ±1.22
4	10.12 ±0.06	15.12 ±0.22	19.00 ±0.35	18.40 ±0.30	22.63 ±0.60	27.83 ±0.22	11.53 ±0.34	19.30 ±1.15	26.12 ±0.46
6	9.75 ±0.12	14.36 ±0.05	18.26 ±0.21	17.23 ±0.05	21.33 ±0.33	26.12 ±1.12	10.12 ±0.15	18.28 ±0.34	23.83 ±0.35
8	9.05 ±0.45	13.67* ±0.30	17.00 ±1.12	16.75 ±0.14	20.47 ±1.20	24.07 ±0.45	9.85* ±1.12	17.40 ±0.42	22.25* ±0.33
10	7.60* ±1.21	13.33* ±1.21	16.40* ±0.35	16.47* ±0.11	20.12* ±0.45	23.67* ±0.32	9.42* ±0.54	17.00* ±0.15	22.00* ±0.15
C.D. at 5% level	**1.20**	**0.75**	**0.84**	**1.12**	**0.95**	**0.98**	**1.34**	**0.72**	**1.41**

DAS: Day after sowing, Conc. : Concentration,* : Non-Significant, Con. : Control

Overall, the maximum increase in root length was 30.0%, 31.25% and 29.15% at 35, 50 and 65 DAS, respectively with 2 ppm in comparison with control. Safflower and sesame also showed similar increasing effect of miraculan on lateral branches but the maximum increase was 43.00% in case of safflower with 2 ppm concentration over control. The cumulative effect of all the concentrations except 10 ppm showed the number of increased laterals from 1 to 3. In sesame, the maximum increase recorded with 2 ppm i.e. 42.82%, 44.23% and 44.35% at 35, 50 and 65 DAS, respectively over control as shown Table-3.

Table 3: Effect of Triacontanol on the Number of Branches/plant in different oil seed crops at different stages of growth (All the data are average of three replicates)

DAS / Conc. (ppm)	Mustard			Safflower			Sesame		
	35	50	65	35	50	65	35	50	65
Con.	3.0 ±0.34	6.0 ±0.35	7.3 ±2.05	3.0 ±1.30	6.3 ±1.22	11.0 ±0.35	2.0 ±0.54	2.7 ±0.35	3.3 ±1.32
2	5.3 ±1.12	8.3 ±0.75	10.0 ±0.34	5.7 ±0.30	10.0 ±0.80	14.0 ±1.25	3.5 ±0.67	5.0 ±0.33	6.7 ±1.33
4	5.0 ±0.54	7.6 ±0.15	9.3 ±0.35	4.0 ±0.15	9.7 ±0.73	13.0 ±1.22	3.0 ±1.23	4.3 ±0.76	5.5 ±0.64
6	4.7 ±0.94	7.0 ±0.34	9.0 ±0.73	3.7 ±0.33	9.2 ±0.25	12.0 ±0.46	2.5 ±1.15	4.0 ±0.34	4.3 ±0.33
8	4.0 ±1.22	6.7 ±0.33	7.7 ±0.33	3.3 ±1.25	8.3 ±0.35	11.7 ±0.36	2.3 ±0.73	3.0 ±0.35	4.6 ±0.45
10	3.3* ±0.32	6.3* ±1.25	7.5* ±0.45	3.0* ±0.45	6.7* ±0.73	11.3* ±0.45	2.0* ±0.33	2.8* ±0.45	3.3* ±0.33
C.D. at 5% level	**0.34**	**0.45**	**0.23**	**0.32**	**0.42**	**0.32**	**0.26**	**0.16**	**0.32**

DAS: Day after sowing, Conc. : Concentration,* : Non-Significant, Con. : Control

In this case, the number of laterals in 2 ppm were more as compared to other treatments and control. As it is clear as shown in Fig. 1.

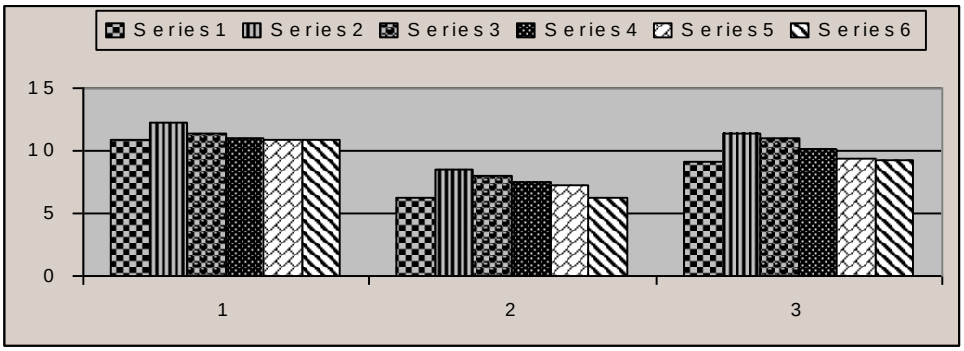

Fig 1: Effect of Triacontanol on the Total Seed Yield per hectare (q/ha) in Mustard, Safflower and Sesame.

All the concentrations significantly enhanced the total yield (q/ha) except 10 ppm in mustard, safflower and sesame. In mustard the maximum increase noticed was 11.96% over control. In safflower and sesame total seed yield increased up to 26.71% and 20.14% with 2 ppm of miraculan as compared to control. Overall, miraculan proved to be more beneficial in case of safflower as compared to mustard and sesame.

The data collected on economic yield over biological yield on the basis of harvest index clearly showed that 2 ppm is the most effective concentrations, Harvest index was increased significantly with all the concentration except 10 ppm. The increase recorded from 3.13% to 36.84% in mustard, 1.43% to 22.27% in safflower and 1.55% to 18.20% in sesame, over control as shown in Fig.-2).

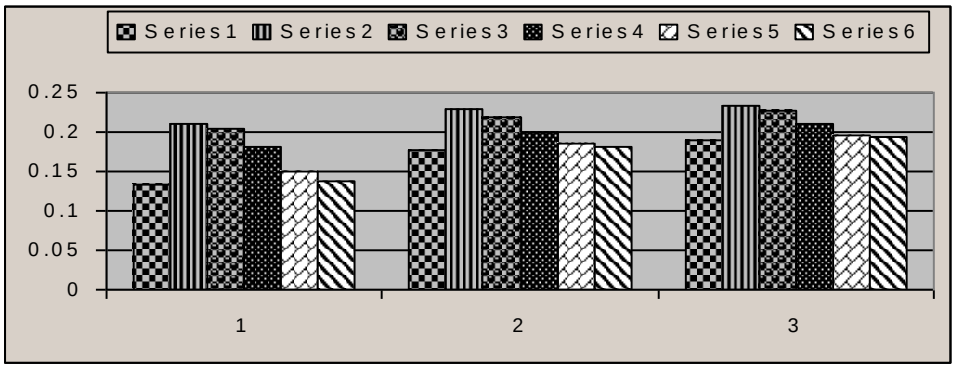

Fig 2: Effect of Triacontanol on the Harvest Index in Mustard, Safflower and Sesame

TRIA is a constituent of plant wax and regulates the metabolic pathway. The effect of TRIA enhanced the uptake of nutrients, increased photosynthesis and yield in many agricultural crops. From the findings of this experiment, it is clear that all the three oil seed crops responded to the treatment of miraculan as foliar spray. As it is clear from the observations that exogenously applied miraculan significantly improved the growth and yield parameters. In present studies, the plant height significantly increased with lower concentrations and 2 ppm was the most effective concentration.

Conclusion

Relating the way that the effect of every single metabolic action showed up on plant development and profitability, the investigations uncovered that chlorophyll and carotenoid substance in leaves and oil content in the seeds were expanded with all the fixations, aside from 10 ppm, while 2 ppm end up being the best, which upgraded the photosynthetic colors giving progressively photosynthetic action to the creating regenerative parts, till the later phases of development. This is thusly give better development and yield. The expanded yield, thus demonstrated more oil content in the seeds. Oil content was expanded with 2 ppm at the degree of 13.57% in mustard; 13.82% and 14.70% in safflower and sesame, individually, over control. Increasing photosynthetic effectiveness give more photosynthates to the developing leafy foods and thusly better yield. Along these lines, miraculan with lower concentrations focuses gainful in all the over three oil-seed crops.

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