Indian J. Agric. Res., **48** (3) 232-236, 2014
doi:10.5958/j.0976-058X.48.3.039

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
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EFFECT OF CLIPPING AND PLANT GROWTH REGULATOR ALONG WITH DIFFERENT KINDS OF FERTILIZERS ON YIELD AND YIELD PARAMETERS IN SESAME (*SESAMUM INDICUM* L.) DURING MONSOON PERIOD

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Received: 06-04-2013 Accepted: 02-04-2014

ABSTRACT

The field experiment was conducted to study suitable production technologies to maximise yield of sesame during the year 2004-2005. The experiment was conducted in randomised block design with thirteen treatments and replicated thrice. The treatment comprises of control, recommended dose of NPK, organic matter, application of biofertilizer, micronutrients, clipping at (0+ 2) leaf stage and planofix spraying of 30 ppm at 45 DAS and 55 DAS with different combinations. Among the treatment T_{12} (*Azospirillum* seed treatment, RD of NPK, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS) has recorded maximum number of capsules per plant (91.12), number of seeds per capsule (69.82), seed yield (1160.75 kg ha^{-1}), stover yield (3133.61 kg ha^{-1}) and harvest index (27.02%). Hence, application of *Azospirillum* as seed treatment, recommended dose of NPK, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS found to be the best production technologies to improve yield.

Key words: Bio fertilizer, Clipping, Micronutrient, NPK, Organic matter, Planofix.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest oil seed crops cultivated in India. It is called as "Queen of oil seed crop" by virtue of its excellent quality. Sesame is very drought-tolerant. It has been called a survivor crop, with an ability to grow where most crops fail. It is popularly known as gingelly, til, benni, ajanjoli, ellu, goma and simsim in different languages. Sesame ranks first for having oil content of 46-64 per cent and 6355 K cal kg^{-1} dietary energy in seeds (Sanjay Kumar and Goel, 1994). Seed of sesame is also rich source of protein (20-28%), sugar (14-16%) and minerals (5-7%) This oil has 85 per cent unsaturated fatty acid is highly stable and has washing effect on cholesterol and prevents coronary heart disease. Sesame as a valued oil seed appears to have numerous industrial applications.

Sesame originated from South West Africa and is botanically termed as *Sesamum indicum* L. of family *Pedaliaceae*. Among top ten oil seed producing countries Mayammar ranks first in production of 0.72 million tonnes with productivity of 0.46 tonnes ha^{-1} fallowed by India which having production of 0.62 metric tonnes and productivity of 0.34 tonnes ha^{-1}. It is clearly indicated that, it is not matching with the increasing demand. The country continues to experience edible oil deficit (Hedge, 2002).A further increase in production could be achieved by adopting improved agronomic practices like proper nutrient management, application of bio fertilizer, micronutrients and growth regulators, reorienting of plant structure, reducing field harvesting losses and storage losses. To achieve this strategy, the field experiment was conducted at Annamalai University with the entitled effect of clipping and plant growth regulator along with different kind of fertilizer on yield parameters in sesame (*Sesamum indicum* L.) during monsoon period.

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MATERIALS AND METHODS

The field experiment was conducted at the Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu, India. The experimental farm is geographically situated at 11°24' North latitude and 79°44' East longitude at an altitude of + 5.79 m above mean sea level. The mean annual rainfall of the experimental farm is 1645.5 mm, with a distribution of 1231.5 mm during North east monsoon, 296.3 mm during South west monsoon and 117.7 mm during hot weather period. The crop has been cultivated between monsoon periods of July to October obtained total rainfall of 358.71mm.

The maximum temperature ranged from 29.0℃ to 36.7℃ with a mean of 32.8℃ while the minimum temperature fluctuated between 19.8℃ and 25.4℃ with a mean of 23.03℃. the highest and lowest relative humidity is 96 and 60 per cent with a mean of 73.41 per cent respectively. The soil of the experimental field is clayey loam, low in available nitrogen, medium in available phosphorus and high in available potassium. The details of the soil characteristics of the experimental field are given in Table 1.

The experimental plot was made in to different bed size of 12 m^2 and the treatments were replicated thrice. The sesame cultivar co -1 was chosen for the study under monsoon condition. The experiment was conducted during July-October (monsoon period) with suitable agronomic practices. The sowing was taken up during 2nd July 2004 and harvested in 7th October 2004.A seed rate of 5 kg $ha^{-1}$was followed. The seeds were mixed with dry sand @ 4 times its volume. The spacing was maintained at 30 cm between two rows and 30 cm between plants. The plant population was maintained by proper thinning at 20 and 30 days after sowing. The gap filling was also done with same time with the same age of seedling. This crop needs irrigation during critical stage of flowering to maturity, number of irrigation has be scheduled as per moisture condition of soil.

TABLE 1: Physical – chemical properties of the experimental field soil.

Soil properties			
Particulars	Physical	Particulars	Chemical
Coarse sand (%)	12.6	pH	7.3
Fine sand (%)	34.2	EC (dsm^{-1})	0.59
Silt (%)	16.0	Organic carbon (%)	0.51
Clay (%)	37.2	Organic matter (%)	0.87
Textural class	Clayey loam	Available N kg ha^{-1}	185.0
		Available P_2O_5 kg ha^{-1}	12.5
		Available K_2O kg ha^{-1}	425.0

According to the treatment schedule some production technologies of organic matter application namely farm yard manure @ 12.5 tonnes/ha , recommended dose of 35:23:23 kg NPK per ha was calculated in term of urea, single super phosphate and murate of potash . At the time of sowing half of nitrogen, entire dose of P_2O_5 and K_2O was applied, the remaining nitrogen applied in two splits at 20 and 30 days after sowing by broadcasting. The seed rate of 5 kg ha^{-1} was fallowed, bio fertilizer of *Azospirillum* was mixed with rice gruel @ 600 g ha^{-1} of seed and shade dry before sowing of seeds. The soil application of Mnso4 @ 5kg/ha was done immediately after sowing. Clipping at (0 + 2) leaf stage was done above the cotyledon by leaving two pairs of leaves at 15-20 DAS. The planofix was sprayed @ 30 ppm concentration in 500 lit of water ha^{-1} at 45 DAS and 55 DAS in order to reduce the flower drops and to improve the seed developments.

The observation of number of capsule per plant was recorded by adding capsule present in the main stem and all branches of the plant in each of five samples and the mean value was calculated. The capsules in each sample plant were selected at random from each treatment plot and were dehisced after sun drying. The total numbers of seeds were counted as per treatment wise and the mean seed number per capsule were calculated and recorded. After threshing and cleaning, the seeds were sun dried plot wise till a constant weight was obtained. Then the seed yield was weighed and recorded separately. The seed yield was later computed to Kg ha^{-1}.The harvest index was calculated by the formula suggested by Verma and Singh (1977).

$$\text{Harvest index percentage} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Data pertaining to various yield parameters were tabulated and statistically analyzed using randomized block design (RBD). The inference was drawn after comparing the calculated F values with the table F values at 5 % (P= 0.05) level of significance.

RESULTS AND DISCUSSION

The data pertaining to yield parameters were tabulated in Table 2 & 3.

Number of capsules per plant: The treatment T_{12} (Recommended dose of NPK, *Azospirillum* seed treatment, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS) excelled all other treatments and recorded the highest number of capsules $plant^{-1}$(91.12). The treatment T_{11} was next in order. The treatments T_2 and T_7, T_3 and T_8, T_4 and T_9 were at par with each other. The least number of capsules $plant^{-1}$of 36.89 was recorded in control (T_0).

The treatment T_{12} might have increased the quantum of photosynthates production and translocation to sink which resulted in increased number of capsules $plant^{-1}$. This was in agreement with the earlier finding of Leopold (2004). Clipping alone registered higher number of capsules per plant. This might be due to increased leaf area index, photosynthetic effect, number of secondary and tertiary branches. Similar findings were reported by Jaffer Basha and Maheswara Reddy (2001). The increased number of capsules per plant might be due to increased flower production, lesser flower drop and reduced shedding of premature reproductive organs. Flower dropping is a major constraint in sesame which is due to the formation of special layer of cells called the "abscission layer" near the base of the petiole which was overcome by spraying of planofix was reported by several workers *viz.*,

TABLE 2: Effect of different treatments on number of capsules per plant and number of seeds per capsule

Treatment	Treatment details	Capsules $plant^{-1}$ (Nos)	Seeds $capsule^{-1}$(Nos)
T_0	Control – No treatment	36.89	33.32
T_1	Recommended dose of NPK + O.M (RD)	42.91	39.47
T_2	*Azospirillum* seed treatment + RD of NPK	48.55	43.92
T_3	T_2 + Soil application of $MnSO_4$ @ 5 kg ha^{-1}	55.02	47.97
T_4	T_1 + Clipping at 0 + 2 leaf stage	61.43	52.61
T_5	T_2 + Clipping at 0 + 2 leaf stage	67.63	56.01
T_6	T_3 + Clipping at 0 + 2 leaf stage	73.63	59.5
T_7	T_1 + Planofix spraying of 30 ppm at 45 and 55DAS	49.43	43.94
T_8	T_2 + Planofix spraying of 30 ppm at 45 and 55 DAS	55.64	48.56
T_9	T_3 + Planofix spraying of 30 ppm at 45 and 55 DAS	62.02	52.69
T_{10}	T_4 + Planofix spraying of 30 ppm at 45 and 55 DAS	79.93	62.75
T_{11}	T_5 + Planofix spraying of 30 ppm at 45 and 55 DAS	86.13	66.34
T_{12}	T_6 + Planofix spraying of 30 ppm at 45 and 55 DAS	91.12	69.82
	SED	3.07	1.91
	CD (p = 0.05)	5.52	3.12

RD - Recommended dose, DAS - Days after sowing

Table 3. Effect of different treatments on seed yield, stover yield and harvest index percentage

Treatment	Treatment details	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
T_0	Control – No treatment	541.23	1907.63	22.1
T_1	Recommended dose of NPK + O.M (RD)	611.13	2008.85	23.32
T_2	*Azospirillum* seed treatment + RD of NPK	669.59	2147.33	23.77
T_3	T_2 + Soil application of $MnSO_4$ @ 5 kg ha^{-1}	729.31	2277.62	24.25
T_4	T_1 + Clipping at 0 + 2 leaf stage	787.95	2371.74	24.93
T_5	T_2 + Clipping at 0 + 2 leaf stage	903.03	2632.09	25.54
T_6	T_3 + Clipping at 0 + 2 leaf stage	957.88	2734.21	25.94
T_7	T_1 + Planofix spraying of 30 ppm at 45 and 55DAS	675.05	2168.22	23.74
T_8	T_2 + Planofix spraying of 30 ppm at 45 and 55 DAS	733.87	2286.31	24.29
T_9	T_3 + Planofix spraying of 30 ppm at 45 and 55 DAS	825.69	2468.73	25.06
T_{10}	T_4 + Planofix spraying of 30 ppm at 45 and 55 DAS	1016.62	2854.44	26.26
T_{11}	T_5 + Planofix spraying of 30 ppm at 45 and 55 DAS	1080.74	2978.49	26.62
T_{12}	T_6 + Planofix spraying of 30 ppm at 45 and 55 DAS	1160.75	3133.61	27.02
	SED	24.57	58.14	0.1
	CD (p = 0.05)	47.7	97.97	0.2

Prakash *et al.* (2003) and Pramasivam *et al.* (2003) in sesame.

Number of seeds per capsule : The highest number of seeds capsule^{-1} was registered under the treatment T_{12} (*Azospirillum* seed treatment, recommended dose of NPK, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS) with the value of 69.82. This was followed by the treatment T_{11}.The treatments T_2 and T_7, T_3 and T_8, T_4 and T_9 were at par with each other. The least number of seeds capsule^{-1} of 33.32 was registered under control (T_0).

The treatment T_{12} (*Azospirillum* seed treatment, recommended doses of NPK, soil application of $MnSO_4$ @ 5kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS) registered highest number of seeds capsule^{-1}. This might be due to synergistic and cumulative effects of nutrients, clipping and growth regulator. The combined application of inorganic and bio fertilizer might have increased the number of seeds per capsule, due to better absorption of applied nutrient by the plant system and increased photosynthetic activity and translocation of nutrients rapidly to the sink. These results were in consonance with the findings of Subramanian *et al.* (1999). Clipping increased the number of seeds per capsule. The present finding of higher number of seeds per capsule due to clipping was in consonance with the earlier reports of Imayavaramban *et al.* (2004).This was also due to application of NAA which might have phloem area of vascular bundle, stalk and capsule. Application of NAA increased the number of seeds per capsule was in confirmation with the results of Mala (1995) and Prakash *et al.* (2003).

Seed yield : Among the treatments, the treatment T_{12} (*Azospirillum* seed treatment, RD of NPK, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage, planofix spraying of 30 ppm at 45 DAS and at 55 DAS) recorded the highest sesame seed yield of 1160.75 kg ha^{-1}. It was followed by T_{11} (*Azospirillum* seed treatment, RD of NPK, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS). The treatments T_2 and T_7, T_3 and T_8, T_4 and T_9 were at par with each other. The least sesame seed yield of 541.23 kg ha^{-1} was recorded under control (T_0).

This might be due to combined application of inorganics and bio fertilizer. The applied nutrients significantly increased all growth and yield attributing traits *viz.*, number of branches plant^{-1}, capsules plant^{-1} and seeds capsule^{-1}.Ramanathan and Chandrasekharan (1998) reported increased seed yield of sesame in clipped plants which might be due to increase in number of branches, capsules plant^{-1} and number of seeds capsule^{-1}.Plant growth regulators increased photosynthetic activity of plant resulting in higher accumulation of photosynthates and consequently higher seed yield was recorded. Gaur and Bansal (1993) and Aravind Kumar *et al.* (2002) reported similar results. Application of NAA increased the seed yield. This finding was in accordance with the report of Mala (1995), Prakash (1998) and Upadhyay*et al.* (2000).

Stover yield : Application of recommended dose of NPK, *Azospirillium* seed treatment soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS (T_{12}) recorded the highest stover yield of 3133.61 kg ha^{-1}. It was followed by recommended dose of NPK, *Azospirillum* seed treatment, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS (T_{11}). The treatments T_2 and T_7, T_3 and T_8, T_4 and T_9 were at par with each other. The least stover yield of 1907.63 kg ha^{-1} was recorded under control (T_0).

The treatment T_{12} (Azospirillum seed treatment, recommended dose of NPK, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0+ 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and 55 DAS) recorded higher Stover yield. The present findings of higher stover yield due to clipping was in consonance with earlier reports of Venkadachalam (2003).The exogenous application of growth regulator might be attributed to higher biomass production, number of branches and utilization of nutrients increased the Stover yield. Similar finding was also reported by Kelaiya *et al.* (1991).

Harvest index percentage : Application of recommended dose of NPK, *Azospirillum* seed treatment, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS (T_{12}) registered the highest harvest index percentage of 27.02. It was followed by T_{11}. The treatments T_2 and T_7, T_3 and T_8, T_4 and T_9 were at par. The least harvest index percentage of 22.10 was recorded under T_0 (control).

Harvest index is a measure of ratio between seed yield and biological yield and represents the ability of physiological capacity of crop (Sink capacity) to mobilize the photosynthates and translocate to economic produce. The treatment T_{12} (*Azospirillum* seed treatment, RD of NPK, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0+ 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and 55 DAS) recorded maximum harvest index percentage. The applied nutrients might have imparted appreciable increments in growth attributes and resulted in translocation of photosynthetic assimilates to sink which in turn increased the value of harvest index. Similar results were reported by Jain *et al.* (2000).

There was significant variation in harvest index due to clipping which might be due to difference in seed and stalk yield. But it was obvious that the highest harvest index was recorded in clipping treatment because of better partitioning of nutrient and other growth factors leading to higher seed yield. Similar findings were reported by Venkadachalam (2003).Increased harvest index was recorded by the application of growth regulator which provided high partitioning efficiency towards sink. This observation was in conformity with the results of Ravichandran (1989) and Prakash (1998) in sesame.

CONCLUSION

This experiment concluded that, application of *Azospirillum* as seed treatment, recommended dose of NPK, soil application of $MnSO_4$ @ 5 kg ha^{-1}, clipping at 0 + 2 leaf stage and planofix spraying of 30 ppm at 45 DAS and at 55 DAS found to be the best production technologies to improve yield.

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