Botany Research International 8 (4): 73-76, 2015
ISSN 2221-3635

DOI: 10.5829/idosi.bri.2015.8.4.525

Influence of Combined Effect of Nitrogen and Micronutrients on Yield and Yield Contributing Characters of Sesame (*Sesamum indicum* L.)

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Abstract: The experiment was conducted at Sher-e-Bangla Agricultural University Research Farm, Dhaka, during April to July 2013 to find out the best combination of different levels of applied nitrogen (N) and micronutrients on growth and yield of sesame (*Sesamum indicum* L.). The experiment were comprised of twelve combinations of different N levels and micronutrients. The interaction effect of different levels of N and micronutrients significantly influenced on almost all yield contributing characters and seed yield of sesame except 1000-seed weight. The highest value of yield contributing characters and seed yield was recorded with the combined dose of N_1M_3 (60 kg N ha^{-1} along with 150 ppm micronutrients) and the lowest values were obtained from control, N_0M_0 (0 kg N ha^{-1} and 0 ppm micronutrients) treatments. The highest yield (1.46 t ha^{-1}) was obtained from 60 kg N ha^{-1} with 150 ppm micronutrients where as the lowest yield (0.59 t ha^{-1}) found with control treatment. So combined use of 60 kg N ha^{-1} with 150 ppm micronutrients have produced highest seed yield of sesame by adjusting yield contributing characters of sesame.

Key words: *Sesamum indicum* · Nitrogen · Micronutrients · Yield

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an important oil crop next to mustard occupying 10.6% of the total oil seed area in Bangladesh [1] which belongs to the family Pedaliaceae. Sesame is a versatile crop having diversified usage and contains 42-45% oil, 20% protein and 14-20% carbohydrate [2]. The present nutritional situation of third world and some developing countries like Bangladesh is a matter of great concern since the most of the people are suffering from malnutrition. Sesame can play an important role in this case and can help to meet up the nutritional deficiency problem of the mass. Oil of sesame is generally used mostly for edible purpose in confectionaries and for illumination. It is also used for some other purposes, such as in manufacture of margarine, soap, paint, perfumery products and drugs and as dispersing agent for different kinds of insecticide. Sesameolin, a constituent of the oil, is used for its synergistic effect in pyrethrum, which increases the toxicity of insecticides [3]. Recently [4] reported that 84,000 acres of land in Bangladesh cultivated for sesame and production was 31,000 metric tons. The yield of sesame may be increased by using numerous improved technologies and practices such as use of high yielding varieties and suitable practices.

It has been reported that nitrogen (N) is one of the most important nutrient elements that accelerate the growth of the plant because it is a constituent of chlorophyll thus ensure crop growth vigorously [5]. The significant response of the number of leaves to N may have led to increase in photosynthetic activity thereby resulting in the improvement of morphological characters i.e. produced more branches and simultaneously enhanced pod production and thus

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increased yield [6]. N has an important role on physiological functions of the plant and supports the plant with rapid growth, increasing seed and fruit production and enhancing quality of leaf and oil seed yield [7]. Unfortunately, soil of Bangladesh contain very low amount of N and need to supply additional fertilizer in proper amount to make sure for better production.

Micronutrients are also essential for plant growth and play an important role in crop production. Deficiency of any one of the micronutrients in the soil can limit growth, even when all other nutrients are present in adequate amounts. They play an important role in cell division and development of meristematic tissues, stimulate photosynthesis, respiration, energy and nucleotide transfer reactions and fasten the plant maturity [8]. The beneficial influence of micronutrients might be due to the activation of various enzymes and the efficient utilization of applied nutrients resulting in increased yield components [9, 10]. However, their deficiencies can cause a great disturbance in the physiological and metabolic processes in the plant [11]. In recent years, soil organic materials and micronutrients have been reduced because of intensive cultivation and continuous chemical fertilizers usage. It is approved that continuance of these conditions lead to destruction of soil structure, biodiversity and agro-ecosystem disorders [12]. Micronutrient deficiency is widespread in many Asian countries due to the calcareous nature of soils, high pH, low organic matter, salt stress, continuous drought, high bicarbonate content in irrigation water and imbalanced application of NPK fertilizers [13]. Foliar nutrition is an option when nutrient deficiencies cannot be corrected by applications of nutrients to the soil [14]. Foliar spraying of microelements is very helpful when the roots cannot provide necessary nutrients [15, 16]. Therefore, the study has been mainly undertaken to investigate the combined effect of N and micronutrients on yield contributing characters and yield of sesame.

MATERIALS AND METHODS

The experiment was carried out at Sher-e-Bangla Agricultural University Research Farm, Dhaka, Bangladesh during April to July 2013. The seeds of BARI Til-4 were collected from Bangladesh Agricultural Research Institute (BARI), Gazipur. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications each. The treatments were different levels of Nitrogen (N) in the form of Urea and micronutrients in the form of Okozym (commercial form of micronutrients as a source of Fe, Zn, Mn and Cu, marketed by Syngenta). Three levels of Nitrogen *viz.* N_0= Without N, N_1= 60 kg N ha^{-1}, N_2= 120 kg N ha^{-1} and four micronutrients levels *viz.* M_0 = Without Micronutrients M_1= 50 ppm Micronutrients, M_2= 100 ppm Micronutrients, M_3 = 150 ppm Micronutrients. By combining this two factors, there were 12 treatment combinations of different N and micronutrients doses used in the experiment were: 1. N_0M_0, 2. N_0M_1, 3. N_0M_2, 4. N_0M_3, 5. N_1M_0, 6. N_1M_1, 7. N_1M_2, 8. N_1M_3, 9. N_2M_0, 10. N_2M_1, 11. N_2M_2, 12. N_2M_3. The unit plot size was 2 m in length and 1.5 m in breadth. The plant to plant distance was maintained as 5 cm in the row and row to row distance was 30 cm. The distance between blocks was 1 m and distance between plots was 0.5 m.

The land was ploughed with a rotary plough and power tiller for four times. After final land preparation sowing was done on 14 April, 2013. According to the layout of the experiment the entire experimental area was divided into blocks and prepared the experimental plot for the sowing of sesame seed. The recommended doses of Triple Super Phosphate (TSP), Muriate of Potash (MOP), Gypsum and Boric acid were applied full dose to the experimental field during land preparation. Half of urea was applied in each plot according to treatment combination and incorporated into soil before sowing seed. Rest of the urea was top dressed after 20 days after sowing (DAS). Micronutrients were applied by foliar spray two times during 20 days after sowing (DAS) and 40 days after sowing (DAS).

Statistical Analyses: All the obtained data were statistically analyzed by using the MSTAT-C computer package program. The mean differences were tested through, least significant difference (LSD) at 5% level of significance.

RESULTS AND DISCUSSION

Number of Pod Plant^{-1}: The number of pod plant^{-1} of sesame significantly influenced by the combined use of applied nitrogen fertilizer and micronutrients (Table 1). The minimum number of pod plant^{-1} (33.33) was observed from control or N_0M_0 (without nitrogen and micronutrients) treatment and maximum number of pod plant^{-1} (58.00) was recorded for the N_1M_3 (60 kg N ha^{-1} and 150 ppm micronutrients) treatment. From the result it appears that pod number plant^{-1} increased due to the increased rate of nitrogen fertilizer application up to

Table 1: Combined effect of nitrogen and micronutrients on the pod number plant^{-1}, pod diameter and pod length of sesame plant

Treatment	Number of pod plant^{-1}	Pod length (mm)	Pod diameter (mm)
$N_0 M_0$	33.33	17.28	7.56
$N_0 M_1$	43.33	18.38	7.99
$N_0 M_2$	44.33	18.99	7.42
$N_0 M_3$	49.66	19.60	8.67
$N_1 M_0$	44.00	21.88	7.72
$N_1 M_1$	48.33	23.83	8.03
$N_1 M_2$	39.00	20.66	8.90
$N_1 M_3$	58.00	24.70	12.00
$N_2 M_0$	43.00	21.36	7.26
$N_2 M_1$	43.66	22.02	7.66
$N_2 M_2$	41.66	18.66	8.36
$N_2 M_3$	48.00	22.66	9.50
LSD (0.05)	5.06	0.98	0.73
Significant level	**	**	**
CV (%)	6.60%	2.77%	5.10%

N_0 = Without nitrogen, N_1= 60 kg ha^{-1} nitrogen, N_2= 120 kg ha^{-1} nitrogen, M_0 = Without micronutrient, M_1 = 50 ppm micronutrient, M_2 = 100 ppm micronutrient, M_3 = 150 ppm micronutrient, CV = Co-efficient of variance and LSD = Least significant Difference. While ** = Significant at 1% level.

Table 2: Combined effect of nitrogen and micronutrients on the seed weight plant^{-1} (g), seed weight plot^{-1} (g), 1000 seed weight (g) and yield (t ha^{-1}) of sesame

Treatments	Seed weight plant^{-1} (g)	Seed weight plot^{-1} (g)	1000 seed weight (g)	Yield (t ha^{-1})
$N_0 M_0$	21.33	223.66	9.90	0.59
$N_0 M_1$	21.66	243.66	10.73	0.69
$N_0 M_2$	22.00	247.00	11.46	0.82
$N_0 M_3$	26.33	253.33	11.03	0.86
$N_1 M_0$	23.66	352.66	10.56	1.20
$N_1 M_1$	22.66	307.66	11.46	1.12
$N_1 M_2$	25.66	255.66	9.86	1.07
$N_1 M_3$	31.00	366.66	11.53	1.46
$N_2 M_0$	20.00	229.00	9.50	0.86
$N_2 M_1$	20.33	270.00	10.20	0.64
$N_2 M_2$	23.66	238.00	9.40	0.68
$N_2 M_3$	28.00	343.33	10.30	1.11
LSD (0.05)	3.13	43.07	2.09	0.1213
Significant level	**	**	NS	**
CV (%)	7.66%	9.05%	11.62%	7.39%

N_0 = Without nitrogen, N_1 = 60 kg ha^{-1} nitrogen, N_2 = 120 kg ha^{-1} nitrogen, M_0 = Without micronutrient, M_1 = 50 ppm micronutrient, M_2 = 100 ppm micronutrient, M_3 = 150 ppm micronutrient, CV = Co-efficient of variance and LSD = Least significant Difference. While ** = Significant at 1% level, NS = Non-significant.

certain level but excess application of nitrogen enhanced the vegetative growth instead of pod formation had also reported by Pathak *et al*. [17] and Ibrahim *et al*. [18].

Pod Length (mm): The maximum pod length (24.70 mm) was recorded for the N_1M_3 (60 kg N ha^{-1} and 150 ppm micronutrient) treatment and the lowest (17.28 mm) was observed from N_0M_0 (without N and micronutrient) treatment (Table 1).

Pod Diameter (mm): The maximum fruit diameter (12.00 mm) was recorded for the N_1M_3 treatment combination and the lowest (7.26 mm) was observed from N_2M_0 treatment combination which was statistically similar with N_0M_0 (7.56 mm), N_2M_1 (7.7.66mm) and N_0M_2 (7.42mm) (Table 1).

Seed Weight Plant^{-1} (g): The minimum seed weight plant^{-1} (21.33 g) was observed from N_0M_0 where as maximum seed weight plant^{-1} (31.00 g) was recorded for the N_1M_3 (Table 2). The results showed that the best combination N_1M_3 (60 kg ha^{-1} N and 150 ppm micronutrient) increased sesame seed weight plant^{-1}. These findings are similar with the findings of Ali *et al*. [19].

Seed Weight Plot^{-1} (g): The highest seed weight plot^{-1} (366.6 g) was recorded for the N_1M_3 (60 kg N ha^{-1} and 150 ppm micronutrient) treatment and the lowest (223.6 g) was observed from N_0M_0 (without N and micronutrient) treatment. These results showed that application of micronutrients with different levels of nitrogen fertilizer increased the seed weight plot^{-1} (g) as consistent to combined effect on seed weight plant^{-1} (g) (Table 2).

1000 Seed Weight (g): The results of this study showed that highest 1000 seed weight (g) of sesame was obtained from N_1M_3 treatment combination (60 kg ha^{-1} nitrogen with 150 ppm of micronutrient) which was similar to the results found in seed weight plant^{-1} (g) and seed weight plot^{-1} (g) (Table 2). This finding is comparable with the results previously published by Kohnaward *et al*. [20].

Yield (t ha^{-1}): The maximum seed yield (1.46 t) was recorded for the N_1M_3 (60 kg N ha^{-1} and 150 ppm micronutrient) treatment combination and the minimum (0.59 t) was observed from N_0M_0 (0 kg N ha^{-1} and 0 ppm micronutrient) treatment. The total yield of sesame increased by the application of different levels of N fertilizer and micronutrients concentration and the best result from the combination of N_1M_3 (60 kg ha^{-1} N and 150 ppm micronutrients) had found from this experiment. Previous results [21] like pod number plant^{-1}, pod diameter (mm), pod length (mm), seed weight plant^{-1} (g), seed weight plot^{-1} (g) (Table 1 and 2) had similarity with these results.

CONCLUSIONS

Different combination of nitrogen and micronutrients exhibited significant variation in respect of growth and yield of sesame. The combination of N_1M_3 treatment combination i.e. 60 kg N ha^{-1} and 150 ppm is optimum for the best growth and yield of BARI Til-4. It may be concluded that yield contributing characters are positively correlated with combined application of N and micronutrients.

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