Morpho-Physiological and Yield Contributing Characters and Yield of Sesame with Different Doses of Nitrogen

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Abstract- The experiment was undertaken in the Farm laboratory of Sher-e-Bangla Agricultural University, Dhaka, during Kharif 1 season, April to July 2013 to examine the response of different levels of nitrogen on morpho-physiology, yield contributing attributes and seed yield of sesame (*Sesamum indicum* L.) variety BARI Til 4. In this experiment, the treatment consisted of three different N levels *viz*. N_0 = 0 kg N/ha, N_1 = 60 kg N/ha and N_2 = 120 kg N/ha. The experiment was laid out in a factors Randomized Complete Block Design (RCBD) with three replications. The total treatment were 3 and plot (3x3) 9. Results showed a significant variation among the treatments in respect of the majority of the observed parameters. The N significantly increased morpho-physiological characters - plant height, number of leaves plant^{-1}, fresh and dry weight of shoot and root; yield contributing characters - number of pod plant^{-1}, pod diameter, pod length, seed weight plant^{-1}, seed weight plot^{-1},thousand seed weight compared to control. The maximum seed yield (1.26 t/ha) was obtained from 60 kg N/ha, whereas (1.01 t/ha) was from 120 kg N/ha which was better than control (0.88 t/ha). Based on the present results, it can be suggested that the use of 60 kg N/ha increased plant morpho-physiological parameters and seed yield of sesame than 120 kg N/ha due to excessive use of this element may produce too much of vegetative growth or toxicity, thus seed production decreased and failed to give highest yield.

Index Terms- Sesame, Nitrogen, Morpho-physiology, Yield

I. INTRODUCTION

Sesame (*Sesamumindicum*L.) is a annually cultivated flower bearing oil crop under the family ofPedaliaceae. It is widely naturalized in tropical regions around the world and is cultivated for its edible seeds, which grow in the form of pods and introduced over 3000 years before. Sesame is highly tolerant to drought or any other environmental variations where other crops may fail to grow. The world harvested about 4.76 million metric tons of sesame seeds in 2013 and the largest producer was Burma. The world's largest exporter of sesame seeds was India and Japan because they use sesame seed in bakery industry (FAO, 2012). Bangladesh ranks twenty and share 0.8% in the total production of sesame in the world. Sesame occupies third position as an oil crop followed by rapeseed and mustard in Bangladesh according to cultivation and production (BARI, 2012). The sesame contains very high percentage of oil, protein and carbohydrate which is tasteless, nutty flavor and plays a vital role in human diet and used as a cuisine across the world (Hansen, 2011). The nutritive value of sesame is excellent due to the most stable vegetable oils, with long shelf life, the high level of natural antioxidants: sesamin, sesamolin, and sesamol which inhibit the development of rancidity in the oil. It has 47 percent oleic and 39 percent linoleic acid and is rich in Omega 6 fatty acid, but lacks Omega 3 fatty acid. It is also used in salad and margarine. The flour that remains after oil extraction is called sesame meal which is an excellent high-protein feed for poultry and livestock (Oplinger *et al.*, 2011). The sesame meal also contains 35 to 50 percent protein, has good effective carbohydrates, and contains water-soluble antioxidants sesaminol, glucosides that provide added shelf-life to many products. Presently, Bangladesh faces an acute shortage of edible oil due to insufficient production of cooked oil in the country. Our production only ensures 4 g of oil per person whereas every man can consume 10g of oil day^{-1}, indicates that extra 6 g added through import from other oil producing countries. Separately, it has been recommended that an adult should consume 22 g oil day^{-1} for better health. Thus we are experiencing 70% deficit of edible oil till to date. To meet up the demand of edible oil we are spending lots of million US dollar every year. Sesame is one of the most important oil crops in Bangladesh and grown in all regions. In the year of 1999-2000, the crop covered an area of 96000 acres in Bangladesh with production of 25000 M tons wereas, recently (BBS, 2013) reported that 84310 acres of land cultivated for sesame and production was 30972 M tons. The above information suggests that although the land of cultivation of sesame is decreasing whereas the production is in increasing trend from 1999 to 2013. But in a view of population growth, the requirement of edible oil is increasing with high in demand than the production. It is therefore, highly expected that the production of edible oil should be increased considerably to fulfill the increasing demand in lower cost. The production may be increased either by increasing cropping area under oil crop or increasing yield. But it is difficult to extent the area of oil production in our country due to over population, high demand of cereal crops etc. That is why; the farmers of our country did not get enough interest to grow oil

crops. Therefore, it is a general consensus that increasing yield per unit area is most reasonable way. The yield of sesame may be increased by using numerous improved technologies and practices such as use of high yielding varieties and suitable practices. As practices, proper balanced supply of nutrients is one of the most important factors to increase higher yield and also decreases the fertilizer cost.

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. 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 increased seed yield (Shehu *et al.,* 2009). The N can contribute to increase seed yield and protein content in seed by synthesizing more protein as N is a part of protein chemistry. Nitrogen (N) has an important role in seed protein and 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 (Allen and Morgan, 2009). Previous many authors showed that the N significantly increased morpho-physiological parameters such as leaf area and rate of photosynthesis etc. Separately, they also reported that N increases the vegetative growth but delayed maturity of seed yielding plants and excessive use of this element may produce too much of vegetative growth, thus food production may be impaired and suggesting that N management is crucial in cropping system and for normal plant growth and development. Unfortunately, N content of Bangladesh soil is very low and need to supply N fertilizer in proper amount in available form and at right time to make sure for better seed production. These results suggest that the optimum doses of N/ha for sesame seed yield is needed to examine. In this study, we used different levels of N to find out the best dose for highest morpho-physiological attributes, yield contributing characters and yield of sesame using variety of BARI Til 4.

II. MATERIALS AND METHODS

The experiment was carried out at Sher-e-Bangla Agricultural University Farm, Dhaka-1207, Bangladesh which located at $90^0 22'$ E longitude and 23°4l′ N latitude at an altitude of 8.6 meters above the sea level under the agro-ecological zone of Modhupur Tract, AEZ-28 during Kharif 1 season, April 2013 to July 2013 to examine the response to different levels of nitrogen (N) on morpho-physiology, yield attributes and yield of sesame variety BARI Til 4. A pest and disease resistant and high yielding variety seed was collected from the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. Before sowing of the seed in the experimental plot, germination test was done in the laboratory and results of percentage of germination were over 90%. The experiment was laid out in a factors randomized complete block design with three replications. Treatments of the experiment was, three different N levels *viz*. N_0 = 0 kg N/ha, N_1 = 60 kg N/ha,N_2= 120 kg N/ha. The total plot number was (3 x 3) 9 and the unit plot size was 2 m x 1.5 m = 3 m^2. The distance between blocks was 1 m and distance between plots was 0.5 m and plant spacing was 30 cm × 5 cm. The final ploughing and land preparation were done on 1 April, 2013. According to the lay out of the experiment the entire experimental area was divided into blocks and prepared the experimental plot for the sowing of sesame seed. In addition, irrigation and drainage channels were made around the plot. Sowing was done on 13 April, 2013 in rows 30 cm apart. Seeds were sown continuously in rows at a rate of 7.5 kg ha^{-1}. After sowing, the seeds were covered with the soil and slightly pressed by hand, and applied little amount water for better germination of seeds. The optimum plant population, 60 plants m^{-2} was maintained by thinning excess plant at 15 DAS. The plant to plant distance was maintained as 5 cm in the row. One weeding with khurpi was given on 25 DAS. Two irrigations were given during immediately after topdressing and 60 DAS with watering can. As per preventive measure seed was treated with a fungicide Vitavex 200 @ 2 g kg^{-1} before showing and fungal disease, Diathen M 45 EC @ 2 ml $litre^{-1}$ of water was applied twice first at 25 DAS and second at 50 DAS. Previous randomly selected ten plants plants from each plot were selected as random and were tagged for the data collection. Some data were collected from 30 days sowing with 10 days interval (Plant height, No. of leaves $plant^{-1}$, No. of primary branches $plant^{-1}$) and some data were collected at harvesting stage during 11-16 July, 2013 (No. of pod $plant^{-1}$, Pod length and diameter, Seed weight $plant^{-1}$ and $plot^{-1}$, Seed weight of 1000 seed and Yield). The sample plants were uprooted prior to harvest and dried properly in the sun (Fresh and dry weight of Shoot). The seed yield $plot^{-1}$ was recorded after cleaning and drying those properly in the sun. The data obtained from the experiment were subjected to statistical analysis following analysis of variance technique. The mean differences were tested through, least significant difference (LSD) method.

III. RESULTS AND DISCUSSION

Plant height (cm)

In this experiment different levels of nitrogen (N) fertilizer showed significant effect on plant height of sesame at 30 days after sowing (DAS), 40 DAS and 50 DAS (Fig. 1). At 30 DAS, the highest plant height (61.31 cm) was observed from the N_1, 60 kg N/ha which was statistically similar with N_2 (59.95 cm) and the lowest (54.17 cm) was observed from N_0, 0 kg N/ha. At 40 DAS, the highest plant height (90.47 cm) was observed from the N_1,60 kg N/ha which was statistically similar with N_2, 120 kg N/ha(90.40 cm) whereas the lowest (86.10 cm) was observed from N_0. At 50 DAS, the highest plant height (121.3 cm) was observed from the N_1 which was statistically similar with N_2 (122.3 cm) whereas the lowest (118.0 cm) was observed from N_0. So the highest plant height at 30 DAS, 40 DAS and 50 DAS was from N_1 (60 kg/ha N) which similar to obsereved by Shilpi *et al*, (2012).

Number of leaf $plant^{-1}$

Nitrogen fertilizers had significant effect on number of leaf $plant^{-1}$ of sesame at 30 DAS, 40 DAS and 50 DAS (Fig. 2). At 30 DAS, the highest number of leaf $plant^{-1}$ (15.42) was observed from the N_1 which was statistically similar with N_2 (15.08) and the lowest (13.08) was observed from N_0. At 40 DAS, the highest number of leaf $plant^{-1}$ (18.25) was observed

from the N_1 which was statistically similar with N_2 (17.08) and the lowest (14.92) was observed from N_0 which was statistically similar with N_2 (17.08). At 50 DAS, the highest number of leaf plant^{-1} (37.67) was observed from the $N_1$and the lowest (30.25) was observed from N_0 which was statistically similar with N_2 (33.50). These findings were similar to Okpara *et al.*, (2007), who reported that increased in such growth characters of sesame due to applied N. Leaf number of sesame plant increased with the increased application of nitrogen fertilizer up to a certain limit was stated by Shilpi *et al*, (2012).

Shoot fresh weight (g)

There was significant variation among the different levels of nitrogen fertilizer doses on shoot fresh weight (g) of sesame (Fig.3). The highest fresh shoot weight (49.17 g) was obtained from N_2 while the lowest result (37.16 g) was recorded from N_0. The results suggest that application of N increased the shoot fresh weight of sesame plant.

Shoot dry weight (g)

Application of different levels of nitrogen fertilizer had significant influenced on dry shoot weight (g) of sesame (Fig. 4). The highest dry shoot weight (7.41 g) was obtained from N_1 which was statistically similar with N_2 (7.20 g) and the lowest result (5.833 g) was recorded from N_0. The results showed that there was not statistical variation in N_1, 60 kg N/ha and N_2, 120 kg N/ha, so it was found that the shoot dry weight of sesame (g) increased with the increasing doses of N.

Root fresh weight (g)

The N showed (Fig. 5) indicated significant variationamong the different doses of nitrogen fertilizer on root fresh weight (g) of sesame. The highest root fresh weight (6.90 g) was obtained from N_1 which is statistically similar with N_2 (6.75 g) treatment while the lowest result (4.66 g) was recorded from N_0 treatment. It can be attributed towards more availability of nitrogen resulting in enhanced vegetative growth.

Root dry weight (g)

Here the results showed that nitrogen fertilizer doses had significantly effected on root dry weight (g) of sesame (Fig. 6). The highest dry root weight (1.75 g) was obtained from $N_1$and the lowest result (1.56 g) was recorded from N_0 which was statistically similar with N_2 (1.60 g). These results showed similarity with shoot dry weight (g) (Fig. 5) and suggested that nitrogen had important role in increased of root dry weight of sesame in application at proper doses.

Number of pod plant^{-1}

A significant variation was recorded due to the different nitrogen fertilizer doses for number of pod plant^{-1} of sesame (Fig. 7).The maximum number of pod plant^{-1} (49.08) was recorded for the N_1 treatment and the lowest (42.37) was observed from N_0 treatment which was statistically similar with N_2 (43.75). From the result it appears that pod number plant^{-1} increased due to the increased rate of nitrogen fertilizer application up to certain level but excess application of nitrogen enhanced the vegetative growth instead of pod formation had reported by Bahar *et al.* (2015) and Shilpi *et al*. (2012). These results are consistent with the vegetative characters of sesame (Fig. 1 and 3).

Pod length (cm):

As consistent to fruit diameter nitrogen fertilizer doses had significant influenced on fruit length (mm) of sesame (Fig. 8). The highest fruit length (21.49 mm) was obtained from N_1 (60 kg N/ha) which was statistically similar with N_2 (20.44 mm) while the lowest result (18.63 mm) was recorded from N_0 (0 kg N/ha). These data resulted that application of N fertilizer increased fruit lenth (mm) in contrast with fruit diameter (mm).

Pod diameter (mm)

Nitrogen fertilizer doses had significant influenced on fruit diameter (mm) of sesame(Fig. 9).The highest fruit diameter (9.85 mm) was obtained from N_1 while the lowest result (8.34 mm) was recorded from N_0 which was statistically similar with N_2 (8.55mm). Here results showed that without and excess nitrogen fertilizer application founded less pod growth in diameter for sesame plant.

Seed weight plant^{-1} (g)

In this study N fertilizer levels showed significant variation in the seed weight plant^{-1} of sesame (Fig. 10). The maximum seed yield plant^{-1} (27.41 g) was produced by N_1 (60 kg N/ha) whereas N_0 produced the minimum seed weight plant^{-1} (21.14 g). This finding corroborated those of Okpara *et al*. (2007), Fathy and Mohammed (2009), Haruna *et al*. (2010).The lowest number of pod seed weight was found from control or without N (N_0).

Seed weight plot^{-1} (g)

The figure 11 showed that different levels of nitrogen fertilizer had significant variation in the seed weight plot^{-1}(g) of sesame. The maximum seed weight plot^{-1}(g) (380.4 g) was produced by N_1 (60 kg/ha) not from N_2 (120 kg/ha) and N_0(0 kg/ha) produced the minimum seed weight plot^{-1} (265.0 g). From the study of results I found that excess nitrogen fertilizer application decrease seed weight plot^{-1}(g). Sesame pod number, pod length and diameter also increased with N, which believe to increase seed weight plot^{-1} of sesame.

1000 seed weight (g)

The application of nitrogen influenced significantly on the thousand seed weight (g) of sesame (Fig. 12). The maximum thousand seed weight (11.18 g) was produced by N_1 and N_0 produced the lowest thousand seed weight (10.29 g). These results showed that without application of nitrogen (N) resulted in minimum 1000seed weight and with the application of N the 1000-seed weight increased and got highest weight from N_1 (60 kg N/ha) .

Yield (t ha^{-1})

The seed yield of sesame plot^{-1} (g) was converted into hectare^{-1} and has been expressed in metric tons. The different levels of nitrogen had significant effect on the yield of seed ton (t) hectare^{-1} as consistent with number of pod, seed weight plant^{-1} (g), seed weight plot^{-1} (g) and 1000 seed weight (g) (Fig.7, 10, 11 and 12). The maximum yield of seed hectare^{-1}(1.26 t) was

obtained from N_1 (60 kg/ha) whereas the minimum yield of seed per hectare (0.88 t) was obtained from N_0 (control or without N). N_1 (60 kg/ha) gave the maximum yield than N_2 (120 kg/ha) this could be because of excessive nitrogen had been reported to reduce fruit number and yield for sesame but enhances plant growth (Fathy & Mohammed, 2009). Kulsum *et al*., (2007) had reported that application of 60 kg N ha^{-1} favored most of the yield contributing characters that contributed the maximum grain yield production.

IV. CONCLUSION

The sesame have both the nutritious as well as high economic value. Bangladesh imports a large amount of sesame every year, so it is highly expected that the production of sesame oil should be increased considerably to fulfill the increasing demand in lower cost. As practices, proper balanced supply of nutrients is one of the most important factors to increase higher yield and also decreases the fertilizer cost.The production hasenhanced by the use of less nitrogen in sesame cultivation. The highest yield obtained from 60 kg/ha Nitrogen, means half of the recommended dose and also decreases the fertilizer cost.

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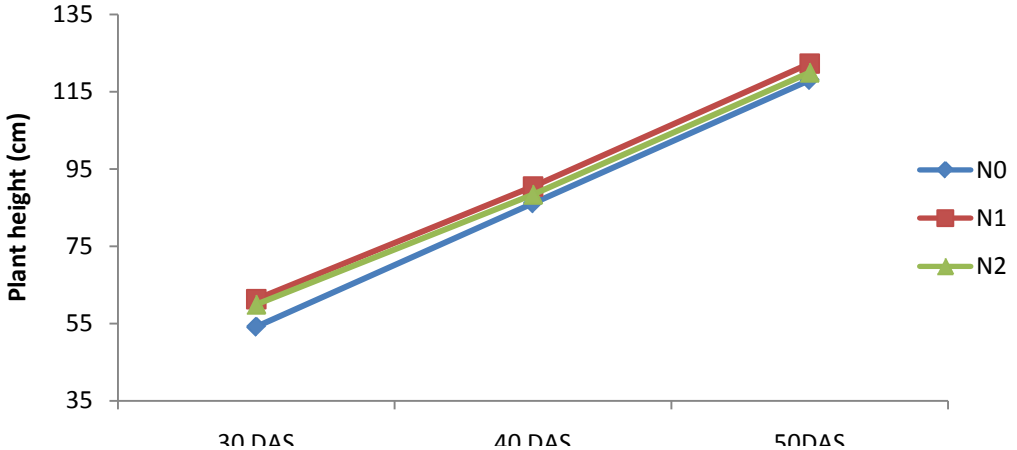
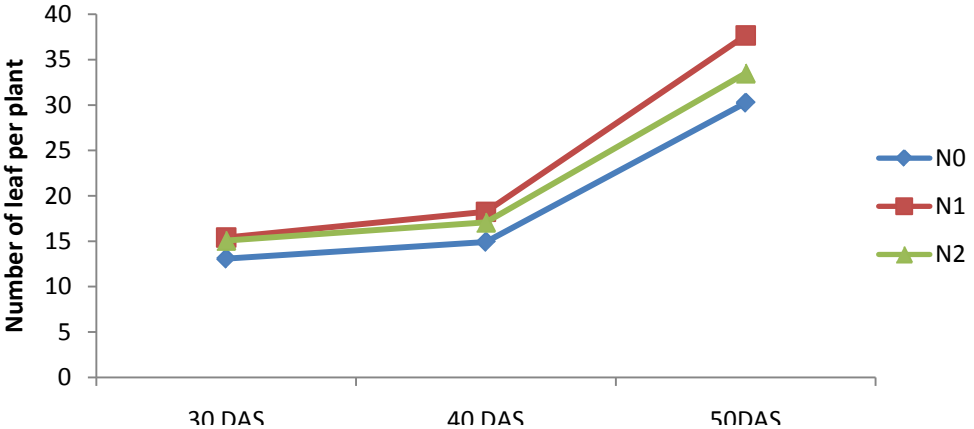


N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea, DAS (Days after sowing)

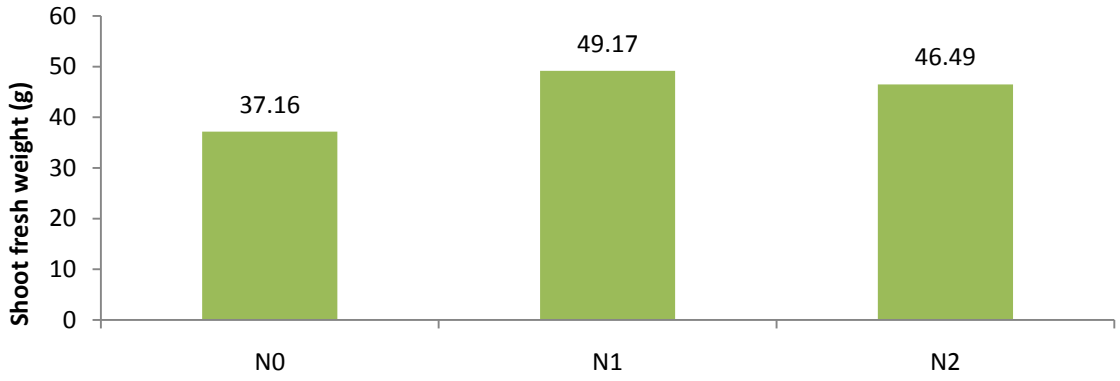
Fig. : 1. Effect of different levels of nitrogen at different days after sowing DAS on the height of sesame plant



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea, DAS (days after sowing)

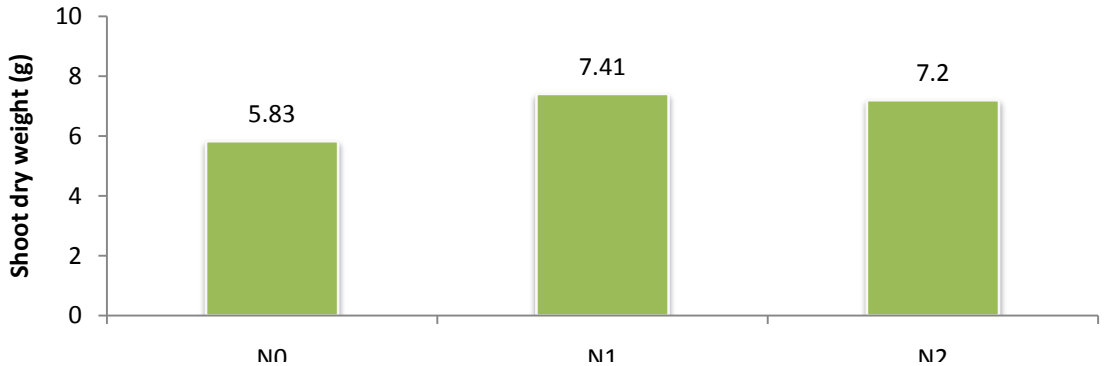
Fig.: 2. Effect of different levels of nitrogen at different DAS on the leaf number of sesame plant



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ha nitrogen applied as urea

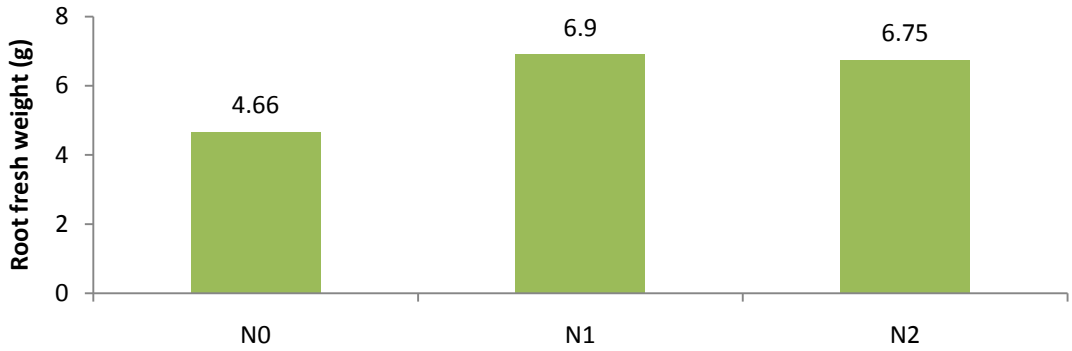
Fig.: 3. Effect of different levels of nitrogen on shoot fresh weight of sesame plant



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

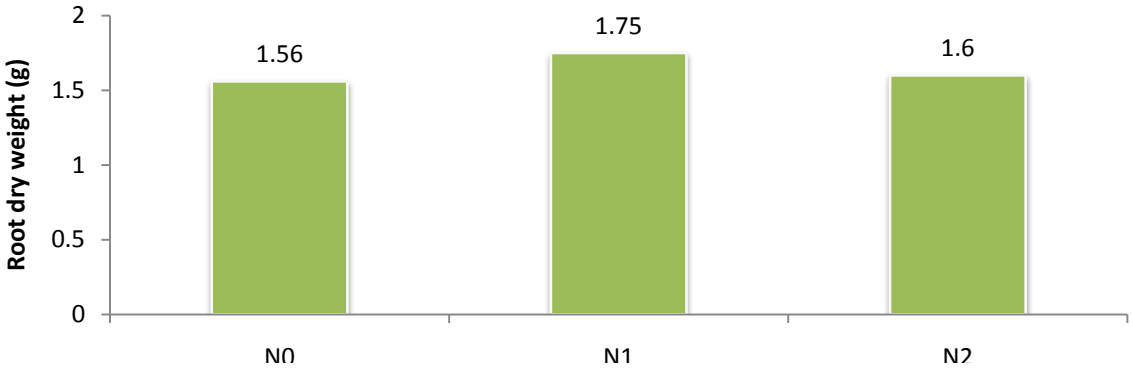
Fig.: 4. Effect of different levels of nitrogen on the shoot dry weight of sesame plant



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

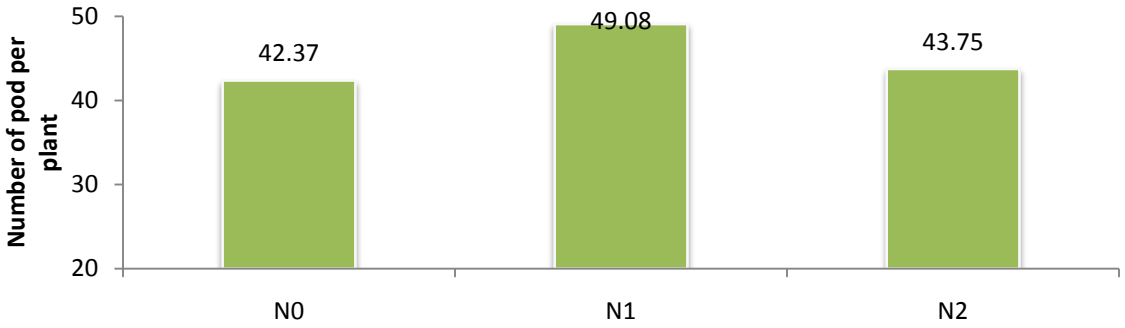
Fig.: 5. Effect of different levels of nitrogen on root fresh weight of sesame plant



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea, DAS = Days after sowing

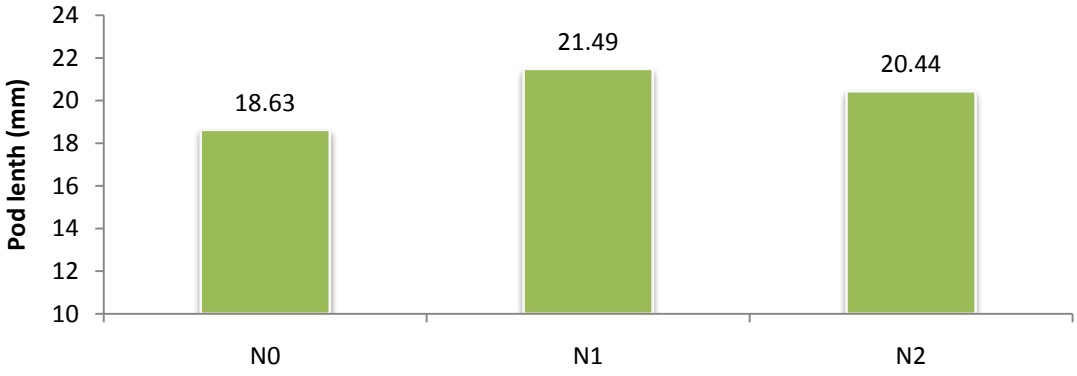
Fig. : 6. Effect of different levels of nitrogen on root dry weight of sesame plant



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

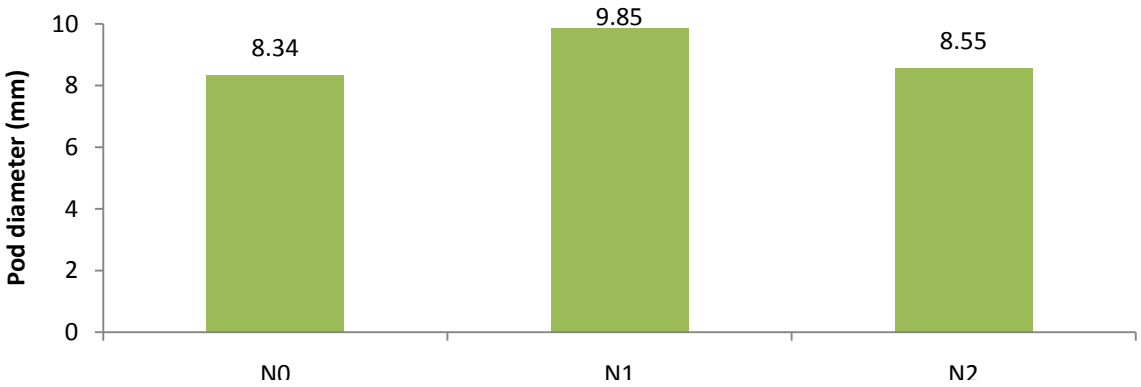
Fig. : 7. Effect of different levels of nitrogen on number pod plant^{-1} of sesame



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

Fig. : 8. Effect of different levels of nitrogen on the pod length of sesame



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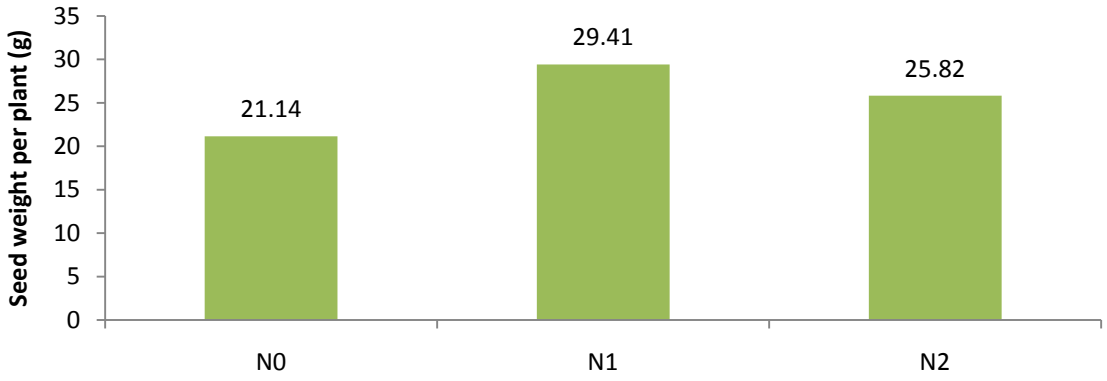
N_2– 120 kg/ ha nitrogen applied as urea

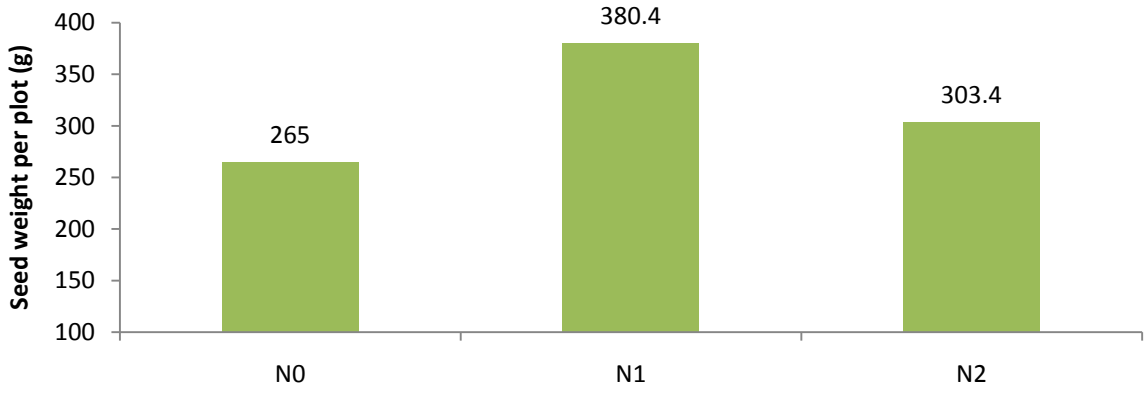
Fig. : 9. Effect of different levels of nitrogen on the pod diameter of sesame



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

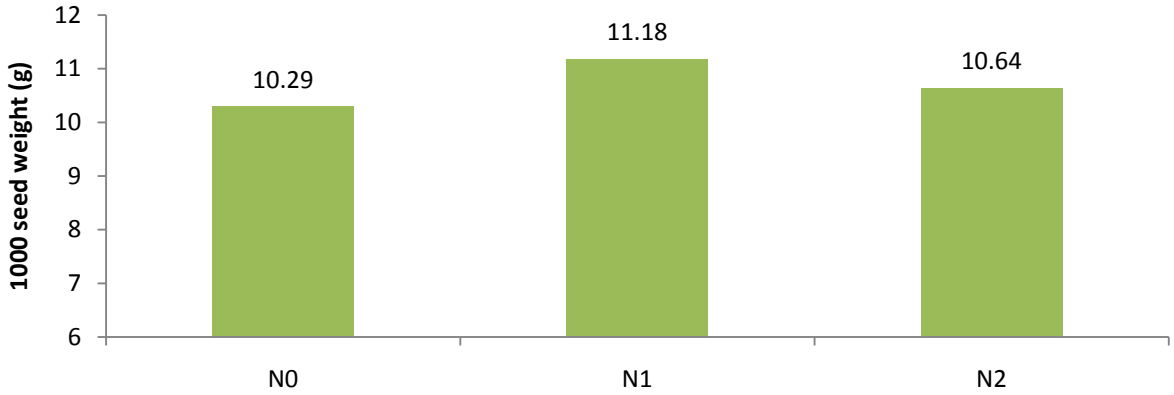
Fig. : 10. Effect of different levels of nitrogen on the seed weight plant^{-1}of sesame



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

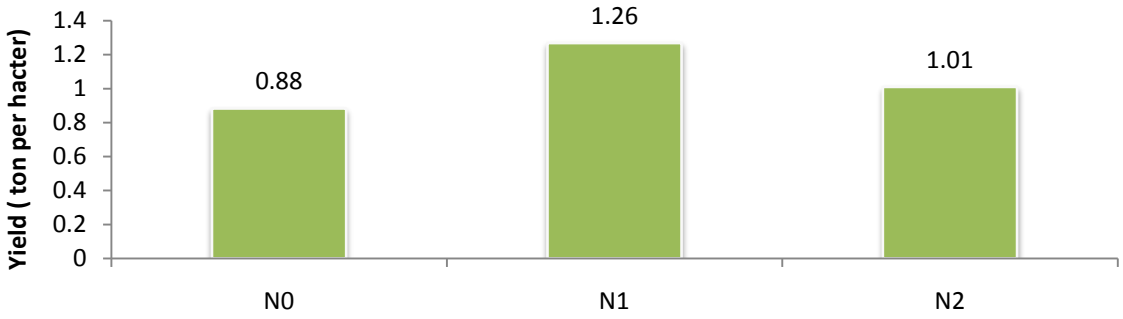
Fig. : 11. Effect of different levels of nitrogen on the seed weight plot^{-1}of sesame



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

Fig. : 12. Effect of different levels of nitrogen on 1000 seed weight of sesame



N_0 – No nitrogen applied, N_1 – 60 kg/ha nitrogen applied as urea ,

N_2– 120 kg/ ha nitrogen applied as urea

Fig. : 13. Effect of different levels of nitrogen on the yield of sesame