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Partitioning of Assimilates in Gladiolus as Influenced by Corm Weight and NPK Levels

L. Rajesh* and A.V.D. Dorajee Rao

Department of Floriculture and Landscape Architecture, HCRI, VR Gudem A.P. India

*Corresponding Author E-mail: rajeshhorti2@gmail.com

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ABSTRACT

The effect of mother corm weight and NPK levels was found to be significant on partitioning of assimilates in gladiolus cv. American Beauty. Maximum leaf area was observed in heaviest corm (>35 g) with NPK levels (40:30:13.5 g m^{-2}). Maximum fresh and dry weight of leaf, stem, floret, spike and whole plant fresh and dry weight was found in heaviest corm (>35 g) with NPK levels (40:30:13.5 g m^{-2}). Spike yield was found maximum in heaviest corm (>35 g) with NPK levels (40:30:13.5 g m^{-2}).

Key words: *Corms, Cormels, Spike, Nitrogen, Phosphorus, Potassium.*

INTRODUCTION

The gladiolus has a long and noble history. The Latin word '*Gladius'* means sword and hence it is often called as 'sword lily' because of its leaf shape. Gladiolus belongs to the family Iridaceae. It is native to South Africa and was introduced into the rest of tropical Africa towards the end of 16th century[8] and to India during early part of 19th century. It stands fourth in the international cut flower trade after carnation, rose and chrysanthemum. Gladiolus being highly responsive crop to nutrition requires large doses of macro nutrients *viz*., nitrogen, phosphorus and potassium[21].

Gladiolus is propagated from corms and cormels which possesses stored food in the form of underground stem. As indicated by Ogale *et al*[18]., a direct relation between corm size, flower production and the corms and cormels yield exist in this crop. The flower quality and spike length of gladiolus can be improved by adopting proper package of cultural practices like, timely planting, proper planting distances between rows and plants, weeding and proper irrigation[14]. It is essential to find out the best corm size on the basis of both corm diameter and weight in order to standardize conventional propagation methods for getting more corm and cormels production besides good quality spikes.

MATERIALS AND METHODS

The present investigation was conducted at HCRI, Venkataramannagudem, Andhra Pradesh during the year 2015-2016. The experiment was laid out in factorial randomized block design with three replications.

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The first factor was corm weight (S) which was taken at 3 levels (S_1: 15 g – 25 g, S_2: 25 g – 35 g and S_3: above 35 g) and the second factor was NPK dose which was also taken at 3 levels (D_1: 20N: 10 P: 4.5 g m^{-2}, D_2: 30N: 20P: 9K g m^{-2} and D_3: 40N: 30P :13.5 K g m^{-2}) thus making 9 treatment combinations in symmetrical factorial concept. The net plot size was 1.8 m x 1.5 m. Nutrients were applied in the form of urea, single super phosphate and muriate of potash, as per treatment combinations. Entire dose of phosphorus and potassium was applied for all the treatment plots as a full dose at the time of bed preparation before planting, however, the nitrogen was applied into three equal splits at 15 DAP, 30 DAP and 45 DAP. All the recommended cultural and plant protection measures were followed. Analysing the nitrogen, phosphorus and potassium by adopting standard analytical procedures[9] and data were analysed statistically.

RESULT AND DISCUSSION

Leaf area

The differences observed in leaf area among the various grades of corm weights and NPK levels and their interactions were found to be significant at all stages of crop growth (**Table 1 and Figure 1**). The mean leaf area increased from 150.17 at 30 days after sowing (DAP) to 705.11 at 90 DAP. The maximum leaf area (775.89 cm^2) at 90 DAP was recorded by S_3 (above 35 g corms) and the minimum leaf area (636.11 cm^2) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum leaf area (727.56 cm^2) at 90 DAP was observed in D_3 (40N: 30P: 13.5K g m^{-2}) and it was on par with D_2 (30N:20P:9K g m^{-2}) (708.33 cm^2) whereas, the minimum leaf area (679.44 cm^2) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}) on par with D_2 (30N: 20P: 9K g m^{-2}) (708.33 cm^2). The interaction effect was also found to be significantly superior in the combination of S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) (802.67 cm^2) which was on par with the S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) (775 cm^2).

More number of leaves and more leaf area was obtained by big sized corms probably because of the reason that the large sized corms contained a large amount of stored food compared to small and medium sized corms thus may result in the production of more number of leaves with increased quantities of stored assimilates in the corms. It will increase leaf area by utilizing the available stored food. More number of leaves and more leaf area signs of vigorous nature of plant and they can contribute a large amount of photosynthetic assimilates.

Nitrogen is the most important constituent of chlorophyll and is a component of amino acids and enzymes, thus it might have increased the meristematic activities, cell division, cell number and cell enlargement of the plant this result more vegetative growth. Similar, results are in conformity with the findings of Kumar and Misra[12].

A comparative examination of leaf area and number of leaves per plant indicated that more the number of leaves per plant more was the leaf area both being lesser at lower nutrient doses as compared to higher nutrient doses. The increase in these parameters with increase in the doses of nutrients was significant only up to D_2 level *i.e.* application of 30N:20P and 9K per m^2. The additional increase up to D_3 could not significantly increase the values in respect of leaf area. There might be more number of leaves but all of them could have been smaller so as to result in relatively on par leaf area with higher dose of nutrient application. As compared to higher levels of nitrogen, phosphorus and potassium significant increase in leaf area was seen only up to D_2 level *i.e.* application of 30N: 20P and 9K per m^2 clearly establishing its optimality under local agro-climatic conditions. Similar findings were reported by Parthiban and Khadar[19], Haitbura and Misra[7], Mahgoub *et al*[15]., Patel *et al*[20]., Kumar and Misra[12] and Shaukat *et al*[23]., in gladiolus. These findings are in accordance with Javid *et al*[10]., in zinnia (*Zinnia elegans*) cv. Giant Dahlia Flowered Blue Point Series, Devi and Singh in tuberose, Kumar and Misra[12] and Shaukat *et al*[23]., in gladiolus.

Fresh weight of leaf and stem

Fresh weight of leaf differed significantly among the various grades of corm weights and NPK levels and their interactions at all stages of crop growth **(Table 2)**. The mean fresh weight of leaf increased from 7.33 g at 30 days after sowing (DAP) to 21.67 g at 90 DAP. The maximum fresh weight of leaf (23.92 g) at 90 DAP was recorded by S_3 (above 35 g corms) and the minimum fresh weight leaf (19.51 g) was observed in S_1 (15 g – 25 g corms). Among NPK levels, the maximum fresh weight of leaf (22.32 g) at 90 DAP was observed in D_3 (40N: 30P: 13.5K g m^{-2}) which was on par with D_2 (30:20:90 g m^{-2}) (22.08 g) whereas, the minimum fresh weight of leaf (20.60 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). Among the combinations S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) was found to possess the maximum fresh weight of leaf (24.42 g) and which was on par with the combination of S_3 (above 35 g corms) + D_2 (30N: 20P: 9K g m^{-2}) (24.15 g) at 90 DAP.

Fresh weight of stem differed significantly among the various grades of corm weights and NPK levels and their interactions at all stages of crop growth **(Table 3).** The mean fresh weight of stem increased from 4.90 g at 30 days after sowing (DAP) to 14.71g at 90 DAP. The maximum fresh weight of stem (17.26 g) at 90 DAP was recorded by S_3 (above 35 g corms) and the minimum fresh weight of stem (11.97 g) was observed in S_1 (15 g – 25 g corms). Among NPK levels, the maximum fresh weight of stem (15.98 g) at 90 DAP was observed in D_3 (40N: 30P: 13.5K g m^{-2}) and whereas, the minimum fresh weight of stem (13.53 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). The interaction effect was also found to be significantly superior in the combination of S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) (18.94 g).

Fresh weight of spike components

Fresh weight of spike components differed significantly among the various grades of corm weights and NPK levels as well as their interactions at all stages of crop growth **(Table 4)**.

In respect of fresh weight of stalk, the highest value (6.88 g) was noticed in S_3 (above 35 g corms). The lowest fresh weight of stalk (5.57 g) was observed in S_1 (15 g – 25 g corms). Regarding NPK level, the corms supplied with D_3 (40N: 30P: 13.5K g m^{-2}) were found to produce heaviest stalk (6.52 g) as against the lightest stalks (6.15 g) produced in D_1 (20N: 10P: 4.5K g m^{-2}). The combination of S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) was found to exhibit significantly the maximum fresh weight of stalk (7.20 g).

The highest fresh weight of rachis (16.7 g) was noticed in S_3 (above 35 g corms). The lowest fresh weight of rachis (8.96 g) was observed in S_1 (15 g – 25 g corms). The corms supplied with D_3 (40N: 30P: 13.5K g m^{-2}) were found to produce heaviest rachis (13.79 g) as against the lightest rachis (11.47 g) produced in those corms supplied with D_1 (20N: 10P: 4.5K g m^{-2}). Among the interactions, S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) resulted in the maximum fresh weight of rachis (17.70 g).

The maximum fresh weight of floret (3.40 g) was noticed in S_3 (above 35 g corms) whereas, the lowest fresh weight of floret (1.13 g) was observed in S_1 (15 g – 25 g corms). Among NPK levels, the corms supplied with D_3 (40N: 30P: 13.5K g m^{-2}) were found to produce heaviest florets (2.48 g) on par with D_2 (30N: 20P: 9K g m^{-2}) (2.45 g) and the lightest florets (1.88 g) were produced in D_1 (20N: 10P: 4.5K g m^{-2}). The interaction effect was also found to be significantly superior in the combination of S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) (3.59 g) which was on par with S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) (3.55 g).

The maximum fresh weight of whole spike (23.15 g) was recorded by S_3 (above 35 g) corms and the minimum fresh weight of spike (15.52 g) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum fresh weight of spike (20.31 g) was observed in D_3 (40N: 30P: 13.5K g m^{-2}) and minimum (17.57 g) in D_1 (20N: 10P: 4.5K g m^{-2}). The combination of S_3 (above 35 g corms) and D_3 (40N: 30P: 13.5K g m^{-2}) was also found to give the maximum fresh weight of whole spike (24 .90g) at 90 DAP among the interactions.

Above ground fresh weight of plant

Above ground fresh weight of plant differed significantly among the various corm grades and NPK levels as well as their interactions at all stages of crop growth **(Table 5)**. The mean fresh weight of above ground plant increased from 12.23 g at 30 days after sowing (DAP) to 57.03 g at 90 DAP. The maximum fresh weight of above ground plant parts (66.56 g) at 90 DAP was recorded by S_3 (above 35 g) corms and the minimum fresh weight of above ground parts (46.46 g) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum fresh weight of above ground plant parts (59 g) at 90 DAP was observed in D_3 (40N: 30P: 13.5K g m^{-2}) and whereas, the minimum above ground fresh weight (53.57 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). Among the interactions, the highest fresh weight of plant (68.26 g) was recorded by S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) at 90 DAP.

Dry weight of leaf and stem

Dry weight of leaf differed significantly among the various corm weights and NPK levels as well as their interactions at all stages of crop growth **(Table 6 and Figure 2).** The mean dry weight of leaf increased from 3.81 g at 30 DAP to 11.19 g at 90 DAP. The maximum dry weight of leaf (12.41 g) at 90 DAP was recorded by S_3 (above 35 g) corms and the minimum dry weight leaf (10.09 g) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum dry weight of leaf (11.59 g) at 90 DAP was observed in D_3 (40N: 30P: 13.5K g m^{-2}) which was on par with D_2 (30N: 20P :9K g m^{-2}) (11.46 g) whereas, the minimum dry weight of leaf (10.53 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). The interaction effect was also found to be significantly superior in the combination of S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) (12.77 g) on par with S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) (12.63 g) at 90 DAP.

Dry weight of stem differed significantly among the various grades of corms and NPK levels as well as their interactions at all stages of crop growth **(Table 7 and Figure 2)**. The mean dry weight of stem increased from 1.62 g at 30 DAP to 4.88 g at 90 DAP. The maximum dry weight of stem (5.73 g) at 90 DAP was recorded by S_3 (above 35 g) corms and the minimum dry weight of stem (3.97 g) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum fresh weight of stem (5.31 g) at 90 DAP was observed in D_3 (40N: 30P: 13.5K g m^{-2}) and whereas, the minimum dry weight of stem (4.48 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). Among the combinations, S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) was found to record the maximum dry weight of stem (6.30 g) at 90 DAP.

Dry weight of spike components

Dry weight of spike components differed significantly among the various corm weights and NPK levels as well as their interactions at all stages of crop growth **(Table 8)**.

In respect to dry weight of stalk, the maximum weight (2.16 g) was recorded by S_3 (above 35 g) corms and the minimum weight of stalk (1.38 g) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum dry weight of stalk (1.91 g) was observed in D_3 (40N: 30P: 13.5K g m^{-2}) whereas, the minimum dry weight of stalk (4.88 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). The combination of S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) was found to have the maximum dry weight of stalk (2.34 g).

The dry weight of rachis was found to be maximum (4.07 g) in S_3 (above 35 g) corms and the minimum weight of rachis (2.24 g) was observed in S_1 (15 g – 25 g) corms. The maximum weight of rachis (3.45 g) was observed in D_3 (40N: 30P: 13.5K g m^{-2}) whereas, the minimum weight of rachis (2.87 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). The combination of S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) was also superior and recorded the maximum value (4.43 g).

The highest dry weight of floret (0.66 g) was recorded by S_3 (above 35 g corms) and the minimum weight of floret (0.27 g) was observed in S_1 (15 g – 25 g) corms. Regarding NPK levels, the maximum dry weight of floret (0.50 g) was observed in D_3 (40N: 30P: 13.5K

g m^{-2}) and which was on par with D_2 (30N: 20P: 9K g m^{-2}) and minimum weight of floret (0.38 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). Among the interactions, S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) and S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) recorded the maximum dry weight of floret (0.69 g).

In respect to dry weight of spike, the maximum weight (6.23 g) was recorded by S_3 (above 35 g) corms and the minimum weight of spike (3.88 g) was observed in S_1 (15 g – 25 g) corms. Application of D_3 (40N: 30P: 13.5K g m^{-2}) among NPK levels, was found to record the maximum weight of spike (5.50 g) whereas, the minimum dry weight of spike (4.51 g) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). The combination of S_3 (above 35 g corms) + D_3 (40N: 30P: 13.5K g m^{-2}) was found to show the maximum dry weight of spike (6.77 g) among the interactions.

Above ground dry weight of plant

Above ground dry weight of plant differed significantly among the various grades of corm weights and NPK levels as well as their interactions at all stages of crop growth **(Table 9)**. The mean dry weight of above ground plant parts increased from 4.68 g at 30 DAP to 21.60 g at 90 DAP. The maximum dry weight of above ground parts (23.77 g) at 90 DAP was recorded by S_3 (above 35 g) corms and the minimum (19.48 g) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum above ground dry weight (22.17 g) at 90 DAP was observed in D_3 (40N: 30P: 13.5K g m^{-2}) on par with D_2 (30N :20P :9K g m^{-2}) (21.91 g) whereas, the minimum dry weight above ground parts (20.71 g) was recorded with the application of D_1 (20N: 10P: 4.5K g m^{-2}). The interaction effect was also found to be significantly superior in the combination of S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) with respect to dry weight (25.84 g) on par with S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) (24.42 g) at 90 DAP.

The fresh and dry weights are indicators of quantities of assimilate production remaining in the plant system at a designated point of time. The fresh weight would be the gross photosynthetic production minus the ignited quantity of total assimilates. A plant wherein more respiration takes place could have left very less amount of photosynthates for storage, but it would be more efficient if it can maintain a high quantum of storage in the form of useful biomass after meeting the requirements of respiration which might have been maintained at optimum rate. Altogether, the efficiency or merit of any treatment would be depicted by measuring the fresh weight of the plant or its part.

Fresh weight includes the weight of moisture which may be differentially held by the plants receiving different treatments. In case a plant is more plumpy it may show more fresh weight but exhibits a lessened value in terms of dry weight, though not compulsory in every case. Dry weights can however follow the trend that is recorded in fresh weight and also directly indicate the net quantum of assimilate production after deducting the respiratory losses. Thus in the present investigation more efficient and productive process of photo assimilation took place in the plants arising from the mother corms with above 35 g weight and receiving the nutritional dose at 40N: 30P: 13.5K per square meter and the interaction between these two also was found to be good, since they recorded the highest fresh weight and dry weight of above ground plant parts. It is interesting note that though the corm grades were significantly different in producing differently weight fresh and dry weights at every level, the increase in either the fresh weight or dry weight was significant only up second level *i.e.* application of 30N: 20P: 9K per square meter. Further increase in nutrient level up to 40N: 30P: 13.5K could not add significantly to the weights as per the critical difference values obtained in the analysis. Therefore, marginal increase in the weight of plant is not paying the marginal increase in the quantity of inputs and thus the application of 30N: 20P: 9K would be the more efficient dose in terms of assimilate production in gladiolus cv.

American Beauty under local agro climatic conditions.

Sharma *et al*[22]., concluded that highest dry weight leaf was obtained with the application of nitrogen and phosphorus at maximum level in gladiolus under Hissar conditions. Amin *et al*[2]., reported significant increase in fresh weight of spike with highest level of phosphorus in tuberose. Potassium helps in water economy, energy metabolism and enzymes activity[16], thus exerting a positive effect on flower weight. Potassium deficiency reduced dry matter accumulation[6]. The experimental results showed that balance dose of potassium with other nutrients could increase fresh and dry flower weight of zinnia which may not be true if the other nutrients are absent[3]. Ahmed *et al*[1]., noticed the highest weight of single spike by application of nitrogen at highest level. Similar trends were noticed by Patel *et al*[20]., Chandana *et al*[5]., Yousif and Mahmoud[25] and Syed *et al*[24]., in gladiolus.

Spike yield

The data **(Table 10 and Figure 3)** revealed that there existed significant differences in respect of number of spikes per corm due to corm weight, NPK levels and their interactions. The maximum number of spikes per corm (4.04) was observed by S_3 (above 35 g) corms and the minimum number of spike per corm (1.24) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum number of spikes per corm (3.14) was observed in D_3 (40N: 30P: 13.5K g m^{-2}) which was on par with D_2 (30N: 20P: 9K g m^{-2}) (3.01) and the minimum number of spike per corm (2.28) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). Among interactions S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) recorded maximum number of spikes per corm (3.14) and it was on par with S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) (3.01).

Significant differences were observed in number of spikes per plot due to various grades of corm weights and NPK levels and their interactions at all stages of crop growth **(Table 10)**. The maximum number of spike per plot (39.30) were observed by S_3 (above 35 g corms) and the minimum number of spike per plot (31.79) was observed in S_1 (15 g – 25 g corms). Among NPK levels, the maximum number of spike per plot (38.06) was observed in D_3 (40N: 30P: 13.5K g m^{-2}) and the minimum number of spike per plot (32.41) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). The combination of S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) recorded maximum number of spikes per plot (42.11) and was on par with S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) (41.78).

The data presented in table 10 indicated that the differences in estimated spike yield per ha due to corm weight, NPK levels and their interactions were significant. The maximum spike yield per ha (98.25 thousands) was estimated for S_3 (above 35 g) corms and the minimum spike yield (79.48 thousands) was observed in S_1 (15 g – 25 g) corms. Among NPK levels, the maximum spike yield per ha (95.15 thousands) was observed in D_3 (40N: 30P: 13.5K g m^{-2}) which was and the minimum spike yield per ha (81.03 thousands) was recorded in D_1 (20N: 10P: 4.5K g m^{-2}). Among interactions, S_3 (above 35 g) corms + D_3 (40N: 30P: 13.5K g m^{-2}) recorded the maximum number of spikes per ha (105.28) on par with S_3 (above 35 g) corms + D_2 (30N: 20P: 9K g m^{-2}) (104.44).

The yield of spikes in terms of number is the penultimate value next only to corm yield because gladiolus has economic value by virtue of both the parts. Heavy mother corms of above 35 g average weight in combination of the nutritional level at 40N: 30P: 13.5K g m^{-2} were found to record maximum number of spikes per corm on par with the combination of the same corms with the next lower nutritional level *i.e.* 30N: 20P: 9K g m^{-2}. The combination of medium sized mother corms + nutritional dose at 40N: 30P: 13.5K g m^{-2} followed them. Whatever the trend we got in terms of the spike number per mother corm, the same was also observed in terms of per plot and per hectare since the plant population was the same in all the plots with different treatment combinations. The yield happened to be the result of various growth attributes as

well as yield contributing or attributing parameters like the weight of spike and its components as well as duration of flowering *etc.* The data on number of sprouts per mother corm on the above treatment combinations directly indicated that there were more sprouts per mother corm and therefore, would have contributed more spikes though variable in size, per mother corm. That is the reason why, heavier corms with nutrient application at 40: 30: 13.5 and 30: 20: 9 proportions could also show better number of spikes per corm followed by medium size corms applied with 40:30:13.5 of NPK g m^{-2}.

It is also elevating the worth of the above treatments, by noticing that they were showing taller plants with higher leaf area per plant as well as the values of leaf area index, crop growth rate *etc.* However, the accumulation of dry matter per gram of dry matter already present and the efficiency of photosynthetic apparatus per unit area as indicated by relative growth rate and net assimilation rate values were not increased with the high yielding treatments. It is clear with the analysis of growth indices that high yielding treatment combinations though not more efficient per unit of leaf area, they showed greater accumulation of dry matter as they were possessing a higher photosynthetic surface sustained over larger period of time. The dry matter assimilated to leaf, stem and spike components was found to be the greatest in heavy corms fed with the 40:30:13.5 and 30:20:9 NPK doses. Such a foundation in the vegetative growth made the plants to develop and transform into reproductive phase at an earliest point of time, but again taking an enlarged period of time to push all those assimilates into spike and/or florets ultimately giving heavier florets in large numbers in the heavier and longer spikes. Thus the number of spikes as well as weight of spikes was significantly superior in the plants produced from the heaviest corms (above 35 g weight) receiving the nutrition at 30N: 20P: 9K and 40N: 30P: 13.5K g m^{-2} being on par with each other.

Bhande *et al*[4]., revealed that large sized corms produced significantly maximum spikes per plant which was closely followed by medium sized corms, however, the least number of spikes per plant were counted with the smaller sized mother corms. Increase in the yield of gladiolus spikes was attributed to be due to the fact that, the plants produced from large sized corms planted at wider spacing might have produced and accumulated more photosynthates (stored food) that would had been diverted to the sink resulted into maximum spike yield in gladiolus. Kamal *et al*[11]., also obtained similar result earlier to them.

Ahmed *et al*[1]., found that increased nitrogen dose could also increase the number of spikes per mother corm. Similarly flower yield per plot as reported by Amin *et al*[2]., was greater at increased doses of phosphorus. Flower yield variations due to increased phosphorus application were also observed in tuberose by many researchers[13,17] .

Table 1: Leaf area (cm^2) as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) (g m^{-2})	30 DAP				60 DAP				90 DAP			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	129.85	140.70	157.50	**142.68**	133.75	144.92	162.23	**146.96**	618.33	670.00	750.00	**679.44**
D_2 (30N:20P:9K)	136.96	151.94	165.85	**151.58**	143.81	159.54	174.14	**159.16**	640.00	710.00	775.00	**708.33**
D_3 (40N:30P:13.5K)	139.75	156.95	172.00	**156.23**	147.44	165.58	181.46	**164.83**	650.00	730.00	802.67	**727.56**
Mean	**135.52**	**149.86**	**165.12**	**150.17**	**141.66**	**156.68**	**172.61**	**156.98**	**636.11**	**703.33**	**775.89**	**705.11**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	2.96		8.83		3.10		9.23		9.99		29.80	
NPK levels	2.96		8.83		3.10		9.23		9.99		29.80	
Interaction (S x D)	5.62		16.78		5.88		17.55		18.97		56.61	

Table 2: Fresh weight of leaf (g) at 30, 60 and 90 DAP as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) ($g\ m^{-2}$)	30 DAP				60 DAP				90 DAP			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	6.09	6.78	7.74	**6.87**	9.14	10.17	11.60	**10.30**	18.27	20.34	23.21	**20.60**
D_2 (30N:20P:9K)	6.67	7.35	8.05	**7.36**	10.01	11.03	12.08	**11.04**	20.02	22.06	24.15	**22.08**
D_3 (40N:30P:13.5K)	6.79	7.76	8.71	**7.75**	10.18	11.64	13.06	**11.63**	20.24	22.31	24.42	**22.32**
Mean	**6.52**	**7.30**	**8.16**	**7.33**	**9.78**	**10.95**	**12.25**	**10.99**	**19.51**	**21.57**	**23.92**	**21.67**
	S Em (+		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.092		0.273		0.103		0.307		0.184		0.549	
NPK levels	0.092		0.273		0.103		0.307		0.184		0.549	
Interaction (S x D)	0.174		0.520		0.196		0.584		0.350		1.044	

Table 3: Fresh weight of stem (g) at 30, 60 and 90 DAP as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) ($g\ m^{-2}$)	30 DAP				60 DAP				90 DAP			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	3.43	4.65	5.45	**4.51**	5.15	6.98	8.17	**6.77**	10.28	13.95	16.35	**13.53**
D_2 (30N:20P:9K)	4.07	5.03	5.50	**4.87**	6.08	7.55	8.25	**7.29**	12.20	15.11	16.51	**14.60**
D_3 (40N:30P:13.5K)	4.47	5.20	6.31	**5.33**	6.70	7.78	9.42	**7.97**	13.42	15.59	18.94	**15.98**
Mean	**3.99**	**4.96**	**5.75**	**4.90**	**5.98**	**7.44**	**8.61**	**7.34**	**11.97**	**14.88**	**17.26**	**14.71**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.098		0.293		0.110		0.328		0.221		0.660	
NPK levels	0.098		0.293		0.110		0.328		0.221		0.660	
Interaction (S x D)	0.187		0.557		0.209		0.623		0.420		1.253	

Table 4: Fresh weight of stalk, rachis, florets and spike (spike components) as influenced by corm weight and NPK levels in gladiolus cv. American Beauty at 90 DAP

NPK levels (D) ($g\ m^{-2}$)	Fresh weight of stalk (g)				Fresh weight of rachis (g)				Fresh weight of floret (g)				Fresh weight of spike (g)			
	Corm weight (S)				Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	5.35	6.35	6.60	**6.10**	8.07	11.93	14.40	**11.47**	0.68	1.90	3.05	**1.88**	13.42	48.28	21.00	**17.57**
D_2 (30N:20P:9K)	5.50	6.70	6.85	**6.35**	9.10	13.30	16.70	**13.03**	1.35	2.45	3.55	**2.45**	14.60	20.00	23.55	**19.38**
D_3 (40N:30P:13.5K)	5.85	6.50	7.20	**6.52**	9.70	13.97	17.70	**13.79**	1.37	2.48	3.59	**2.48**	15.55	20.47	24.90	**20.31**
Mean	**5.57**	**6.51**	**6.88**	**6.32**	**8.96**	**13.07**	**16.27**	**12.76**	**1.13**	**2.28**	**3.40**	**2.27**	**14.52**	**19.58**	**23.15**	**19.09**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.048		0.144		0.244		0.729		0.094		0.282		0.241		0.719	
NPK levels	0.048		0.144		0.244		0.729		0.094		0.282		0.241		0.719	
Interaction (S x D)	0.092		0.274		0.464		1.385		0.179		0.535		0.458		1.365	

Table 5: Above ground fresh weight of plant at 30, 60 and 90 DAP as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) ($g\ m^{-2}$)	30 DAP				60 DAP				90 DAP			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	12.18	15.38	18.08	**15.21**	24.37	30.75	36.17	**30.43**	41.97	52.57	60.55	**51.70**
D_2 (30N:20P:9K)	13.49	16.39	18.78	**16.22**	26.98	32.78	37.57	**32.44**	46.81	57.17	64.21	**56.06**
D_3 (40N:30P:13.5K)	14.46	17.12	19.51	**17.03**	28.92	34.23	39.02	**34.06**	49.21	58.37	68.26	**58.61**
Mean	**13.38**	**16.29**	**18.79**	**16.15**	**26.76**	**32.59**	**37.58**	**32.31**	**46.00**	**56.04**	**64.34**	**55.46**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.194		0.577		0.361		1.078		0.656		1.957	
NPK levels	0.194		0.577		0.361		1.078		0.656		1.957	
Interaction (S x D)	0.368		1.097		0.686		2.048		1.246		3.719	

Table 6: Dry weight of leaf at 30, 60 90 DAP as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) ($g\ m^{-2}$)	30 DAP				60 DAP				90 DAP			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	3.16	3.42	3.95	**3.51**	4.74	5.14	5.92	**5.27**	9.48	10.28	11.84	**10.53**
D_2 (30N:20P:9K)	3.44	3.80	4.21	**3.82**	5.17	5.71	6.32	**5.73**	10.33	11.41	12.63	**11.46**
D_3 (40N:30P:13.5K)	3.47	4.05	4.76	**4.09**	5.24	6.07	7.15	**6.16**	10.45	11.54	12.77	**11.59**
Mean	**3.36**	**3.76**	**4.31**	**3.81**	**5.05**	**5.64**	**6.46**	**5.72**	**10.09**	**11.07**	**12.41**	**11.19**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.034		0.102		0.047		0.141		0.083		0.249	
NPK levels	0.034		0.102		0.047		0.141		0.083		0.249	
Interaction (S x D)	0.065		0.193		0.090		0.269		0.158		0.473	

Table 7: Dry weight of stem at 30, 60 and 90 DAP as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) ($g\ m^{-2}$)	30 DAP				60 DAP				90 DAP			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	1.13	1.53	1.80	**1.49**	1.70	2.30	2.70	**2.23**	3.40	4.62	5.40	**4.48**
D_2 (30N:20P:9K)	1.34	1.67	1.83	**1.62**	2.07	2.52	2.75	**2.44**	4.06	5.00	5.49	**4.85**
D_3 (40N:30P:13.5K)	1.47	1.72	2.08	**1.76**	2.22	2.58	3.13	**2.64**	4.44	5.20	6.30	**5.31**
Mean	**1.31**	**1.64**	**1.91**	**1.62**	**1.99**	**2.47**	**2.86**	**2.44**	**3.97**	**4.94**	**5.73**	**4.88**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.021		0.063		0.029		0.086		0.063		0.188	
NPK levels	0.021		0.063		0.029		0.086		0.063		0.188	
Interaction (S x D)	0.040		0.120		0.055		0.164		0.120		0.358	

Table 8: Dry weight of stalk, rachis, florets and spike (spike components) as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) (g m^{-2})	Dry weight of stalk (g)				Dry weight of rachis (g)				Dry weight of floret (g)				Dry weight of spike (g)			
	Corm weight (S)				Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10K:4.5K)	1.26	1.65	2.02	**1.64**	2.02	2.98	3.60	**2.87**	0.16	0.37	0.59	**0.38**	3.28	4.63	5.62	**4.51**
D_2 (30N:20P:9K)	1.40	1.75	2.12	**1.76**	2.28	3.33	4.18	**3.26**	0.33	0.47	0.69	**0.49**	4.03	5.08	6.30	**5.14**
D_3 (40N:30P:13.5K)	1.48	1.90	2.34	**1.91**	2.43	3.49	4.43	**3.45**	0.33	0.47	0.69	**0.50**	4.33	5.39	6.77	**5.50**
Mean	**1.38**	**1.77**	**2.16**	**1.77**	**2.24**	**3.27**	**4.07**	**3.19**	**0.27**	**0.44**	**0.66**	**0.46**	**3.88**	**5.03**	**6.23**	**5.05**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.028		0.083		0.051		0.152		0.014		0.041		0.084		0.250	
NPK levels	0.028		0.083		0.051		0.152		0.014		0.041		0.084		0.250	
Interaction (S x D)	0.053		0.157		0.097		0.289		0.026		0.079		0.159		0.476	

Table 9: Above ground dry weight of plant at 30,60 and 90 DAP as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) (g m^{-2})	30 DAP				60 DAP				90 DAP			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	4.07	4.41	4.94	**4.47**	16.28	17.69	19.75	**17.91**	16.78	19.53	22.86	**20.71**
D_2 (30N:20P:9K)	4.25	4.72	5.15	**4.71**	17.26	19.15	20.91	**19.11**	18.42	21.49	24.42	**21.91**
D_3 (40N:30P:13.5K)	4.34	4.87	5.34	**4.85**	17.35	19.49	21.36	**19.40**	19.22	22.13	25.84	**22.17**
Mean	**4.22**	**4.67**	**5.14**	**4.68**	**16.97**	**18.78**	**20.67**	**18.80**	**19.48**	**21.54**	**23.77**	**21.60**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.09		0.28		0.37		1.11		0.31		0.91	
NPK levels	0.09		0.28		0.37		1.11		0.31		0.91	
Interaction (S x D)	0.18		0.52		0.70		2.10		0.58		1.73	

Table 10: Number of spikes per corm, plot and estimated spike yield per ha as influenced by corm weight and NPK levels in gladiolus cv. American Beauty

NPK levels (D) (g m^{-2})	Number of spikes per corm				Number of spike per plot				Estimated spike yield per ha (Thousands)			
	Corm weight (S)				Corm weight (S)				Corm weight (S)			
	S_1 (15-25 g)	S_2 (25-35 g)	S3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**	S_1 (15-25 g)	S_2 (25-35 g)	S_3 (>35 g)	**Mean**
D_1 (20N:10P:4.5K)	1.00	2.46	3.38	**2.28**	30.89	32.33	34.01	**32.41**	77.22	80.83	85.03	**81.03**
D_2 (30N:20P:9K)	1.35	3.35	4.35	**3.01**	32.11	33.67	41.78	**35.85**	80.28	84.17	104.44	**89.63**
D_3 (40N:30P:13.5K)	1.36	3.65	4.39	**3.14**	32.37	39.70	42.11	**38.06**	80.93	99.25	105.28	**95.15**
Mean	**1.24**	**3.15**	**4.04**	**2.81**	**31.79**	**35.23**	**39.30**	**35.44**	**79.48**	**88.08**	**98.25**	**88.60**
	S Em		CD at 5%		S Em		CD at 5%		S Em		CD at 5%	
Corm weight	0.090		0.267		0.209		0.623		0.671		2.003	
NPK levels	0.090		0.267		0.209		0.623		0.671		2.003	
Interaction (S x D)	0.170		0.508		0.397		1.184		1.275		3.805	

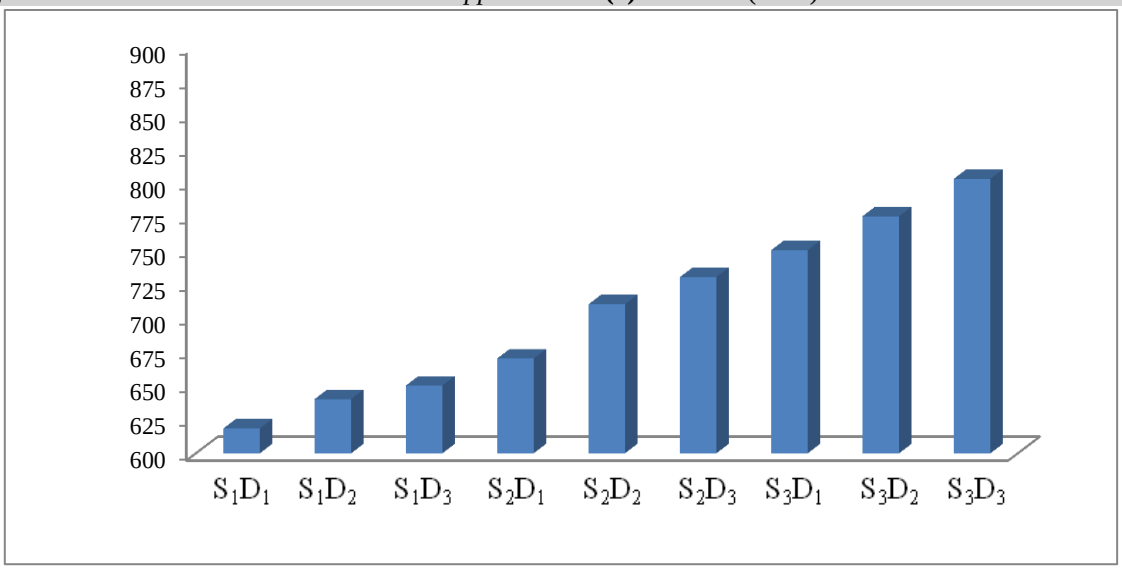
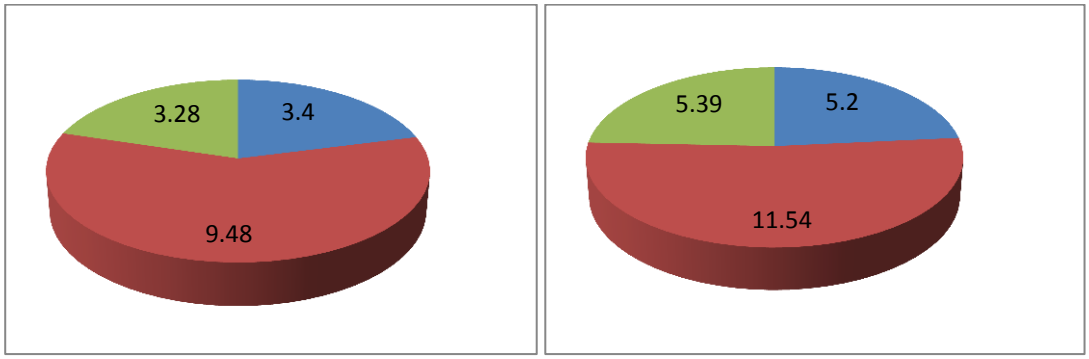


Fig. 1: Leaf area (cm^2) as influenced by corm weight and NPK levels

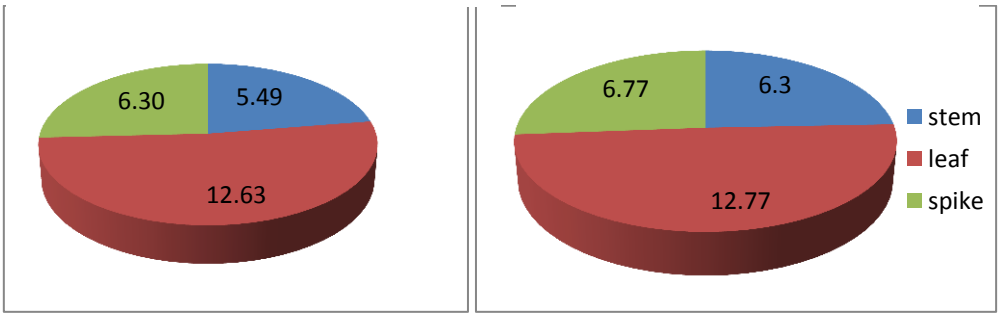
LEGEND

S_1D_1: Corm weight (15 g – 25 g) + 20N: 10P: 4.5K g m^{-2}
S_1D_2: Corm weight (15 g – 25 g) + 30N: 20P: 9K g m^{-2}
S_1D_3: Corm weight (15 g – 25 g) + 40N: 30P: 13.5K g m^{-2}
S_2D_1: Corm weight (25 g – 35 g) + 20N: 10P: 4.5K g m^{-2}
S_2D_2: Corm weight (25 g – 35 g) + 30N: 20P: 9K g m^{-2}
S_2D_3: Corm weight (25 g – 35 g) + 40N: 30P: 13.5K g m^{-2}
S_3D_1: Corm weight (above 35 g) + 20N: 10P: 4.5K g m^{-2}
S_3D_2: Corm weight (above 35 g) + 30N: 20P: 9K g m^{-2}
S_3D_3: Corm weight (above 35 g) + 40N: 30P: 13.5K g m^{-2}



S_1D_1: Corm weight (15 g – 25 g)
+
20N: 10P: 4.5K g m^{-2}

S_2D_3: Corm weight (25 g – 35 g)
+
40N: 30P: 13.5K g m^{-2}



S_3D_2: Corm weight (above 35 g)
+
30N: 20P: 9K g m^{-2}

S_3D_3: Corm weight (above 35 g)
+
40N: 30P: 13.5K g m^{-2}

Fig. 2: Partitioning of above ground dry weight of plant as influenced by corm weight and NPK levels

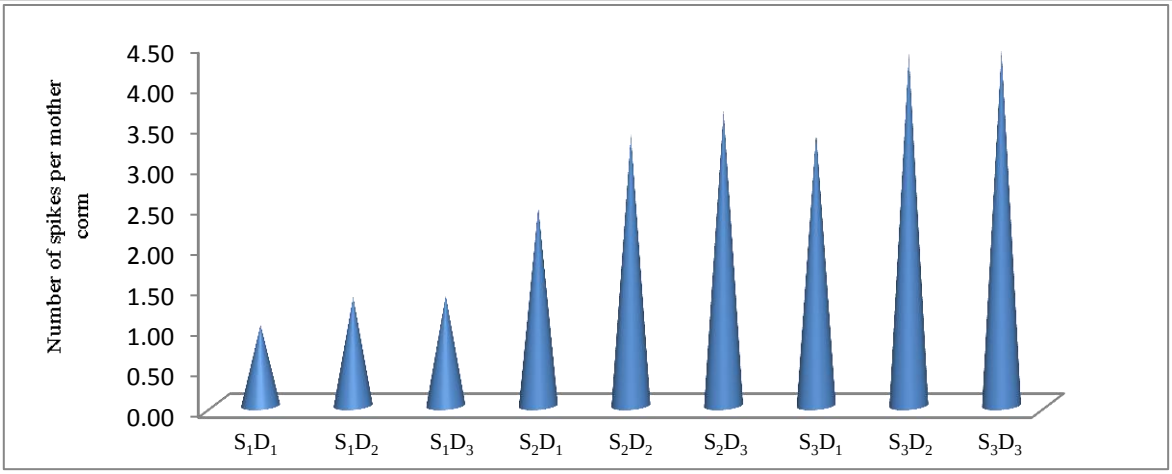


Fig. 3: Number of spikes per mother corm as influenced by corm weight and NPK levels

Legend

S_1D_1: Corm weight (15 g – 25 g) + 20N: 10P: 4.5K g m^{-2}
S_1D_2: Corm weight (15 g – 25 g) + 30N: 20P: 9K g m^{-2}
S_1D_3: Corm weight (15 g – 25 g) + 40N: 30P: 13.5K g m^{-2}
S_2D_1: Corm weight (25 g – 35 g) + 20N: 10P: 4.5K g m^{-2}
S_2D_2: Corm weight (25 g – 35 g) + 30N: 20P: 9K g m^{-2}
S_2D_3: Corm weight (25 g – 35 g) + 40N: 30P: 13.5K g m^{-2}
S_3D_1: Corm weight (above 35 g) + 20N: 10P: 4.5K g m^{-2}
S_3D_2: Corm weight (above 35 g) + 30N: 20P: 9K g m^{-2}
S_3D_3: Corm weight (above 35 g) + 40N: 30P: 13.5K g m^{-2}

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