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# Effect of various combinations of nitrogen, phosphorus and potash on enhancing the flowering time in Chrysanthemum (*Chrysanthemum morifolium*)

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**Key words:** Chrysanthemum flowering, early flowering, fertilizers.

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**Abstract**

The experiment was conducted at Hazara Agriculture Research Station Abbottabad, Pakistan during 2010-11 to evaluate the impact of various N, P, K combinations (Control, Nitrogen (N), Phosphorus (P), Potash (K), N+P, N+K, P+K and N+P+K) on plant height, number of branches, suckers, leaves, flowers per plant, leaf area, days to flowering, blooming period, flower size and flower fresh weight. The experiment was conducted as a Completely Randomized Block Design with 8 treatments replicated 4 times. Terminal cuttings were individually planted in 7 cm plastic pots on 10th June. Plants were transplanted to 28 cm pots on 10th July. Application of fertilizer with (N+P+K) combination was significantly better with plant height (63.9 cm), maximum leaf area (131.6 $cm^2$), less days (116) to flower, more number of flowers (32), maximum blooming period (38 days), larger flower size (6.3 cm) and flower fresh weight (4.4 g). Untreated chrysanthemum plants had least plant height (46.5 cm), number of branches (7) per plant, number of leaves (47) per plant, leaf area (94.2 $cm^2$), number of flowers (15) per plant, blooming period (35 days), flower size (4.5 cm) and fresh weight (3.3 g). Treatment of plants with (N+P+K) combination alone gave flowering after 116 days from planting in 7 cm pots and produced flowers on 4th October which was earlier than the normal season.

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**Introduction**

Fertilizers are substances containing chemical elements that improve the growth of plants. When fertilizers are applied to soil or water, plants can develop tolerance against pests such as weeds, insects and diseases with improved health (Alam and Khan, 1999). Fertilizers can help plants to overcome situations like drought conditions by increasing their capacity to hold more water and improve the rooting depth (Alam and Khan, 1999).

Fertilizers can also help in promoting healthy growth of plants and their development. Nitrogen in plants acts as vegetative growth enhancer. Phosphorus helps in the quick formation of seeds and root development. The potassium found in fertilizers helps to make the stems and straws of plants stronger. N, P, K fertilization can not only increase economic return of the investment through better yield and quality, but also able to minimize environmental dangers (Hera, 1996).

Nitrogen is considered to be the most critical for plant and development. It is applied in nitrate or ammonium form. It is the constituent of protein and nucleic acid, which is helpful in plant growth (Haque and Jakhro, 2001). Higher concentration of nitrogen has the ability to increase the number of cells of leaves, cell size and an overall leaf production (Meyer *et al.,* 1973; Sigedar *et al*., 1991). Studies revealed an increase in number of leaves, the plant height and number of branches (Arora and Khanna, 1986). Belgaonkar *et al.* (1996) reported that chrysanthemum plants grew taller with more number of primary and secondary branches and took fewer days for flowers to open when 200 kg N per ha was applied.

Higher doses of nitrogen application resulted in delayed flowering and taller plants in chrysanthemum as reported by Wordsworth and Butters (1973) and Belgaonkar *et al.* (1996). Shyam (1986) observed delayed flower initiation in marigold with higher dose of nitrogen application.

Phosphorus is the essential component of protoplasm and chlorophyll material which causes conversion of photosynthates into phospholipids, resulting adequate vegetative growth. Its higher dose i.e 200 kg $P_2O_5$ per ha causes influence on flowering parameters like delay in flowering, increase in flower number and flower size (Monish *et al*., 2008).

Plant growth, number of flowers, flower size and flowers longevity was increased with the highest dose of N and $P_2O_5$ rates (Bhattacharjee and Mukherjee, 1983). Significant increase has been recorded in most of the vegetative characters like number of leaves, number of branches and stem diameter by phosphorus application (Singh and Sangama, 2000, Kumar *et al.,* 2003).

Potassium is also one of the most important nutrient that effect plant growth and development. It is crucial for the process of membrane transport, stomatal opening, plant cell osmotic potential, and is an activator of several enzymes. Mainly those enzymes that are involved in plant cell respiration and photosynthesis (Marschner, 1995). Potassium activates enzymes involved in photosynthesis, where its essential function on $CO_2$ fixation is clearly demonstrated with isolated intact chloroplasts (Borgatto *et al*., 2002). Potassium has been investigated to be involved in the synthesis of peptide bond, protein and carbohydrate metabolism, and helps in rapid cell division and differentiation (Belorkar *et al.,* 1992). The application of phosphorus and potassium significantly reduced the time taken to flower opening in sunflower (Tripathi and Kalra, 1981).

Keeping in view the above mentioned facts, this study was conducted to quantify the influence of different combinations of fertilizers to enhance the flowering time of chrysanthemum and to evaluate the best suitable nutrient combination for chrysanthemum to achieve early flowering.

**Materials and methods**

The research study was carried out during growing

season 2010-11 at Hazara Agriculture Research Station Abbottabad Khyber Pakhtunkhwa, Pakistan to evaluate the effect of different combinations of N, P and K on chrysanthemum flowering and other plant characters. The experiment was laid-out in Completely Randomized Design with 8 N, P and K combinations.

*Plant Material*

Terminal cuttings each having 8 cm length were taken from the stock and planted in 7 cm plastic pots individually on 10th June. The pots were filled with 2 parts leaf mold and one part silt and were placed in well exposed ambient conditions. Plants were transplanted to 28 cm pots on 10th July. Each pot contained 5 Kg potting media. Potting media was analyzed for nutrients status before filling in pots.

*Fertilizers*

The fertilizers were weighed on electronic balance carefully. All phosphorus and potash and half dose of nitrogen was applied to the plants at transplanting. The remaining half dose of nitrogen was applied after 15 days of first application.

There were total eight treatments including control, Nitrogen (520 mg), Phosphorus (430 mg), Potash (400 mg), N+P, N+K, P+K and N+P+K.

All the cultural practices were kept uniform for all the treatments in the experiment.

*Data Analysis*

The experiment with all same inputs and treatments was repeated in 2011 and average data of both years were analyzed at the end providing year wise detail and interaction between year and fertilizer was calculated using computer statistical software "Statistix 9.0". (www.statistix.com). Statistical significance is given at $p < 0.05$.

*Vegetative Characters*

The physical traits considered included plant height which was the measure of stem length from the crown to the top of the stem. The number of branches plant $^{-1}$ grown on plant were counted and recoded after the last flower harvested. All the leaves grown on plant were counted and recorded after the last flower harvested. Leaf area was measured with the help of an automatic Leaf Area meter (Model, Delta- T Devices Ltd., Burwell Bs, UK).

*Flowering Characters*

Days taken to flowering were counted from date of transplanting to 7 cm plastic pots (10th June) till the date of flower bud opening. The number of flowers, flower size (diameter) and fresh weight were then taken after harvest. All flowers grown on the main stalk and the side branches were counted up to the last flower harvested. Number of days from flower bud break till its petal fadding were counted. The flower size was recorded by measuring the diameter of the flower in cm. Full bloomed flowers were excised and weighed on electronic balance individually.

**Results and discussions**

*Vegetative Characteristics*

*Plant height (cm)*

Various combinations of N, P and K affected plant height, while plant height did not influenced by year and the interactive effect of year and fertilizer. Maximum plant height (63.9 cm) was recorded when plants were treated with N+P+K as compared to the untreated plants (46.5 cm). Untreated plants and plants treated with N, P, N+P, P+K and N+P+K showed significant difference while the rest of the treatments were non significantly different from each other (Table 1).

The superiority of N+P+K over the others might be attributed to the availability of three major nutrients that may led to an enhanced growth as a result of increased cell division, cell enlargement and maximum conversion of photosynthates to plant growth. Similar results of higher plant height due to the combined use of N, P and K have been reported by Verma *et al.* (2011) in chrysanthemum. Javid *et al.* (2005) noticed increase in height with the application of NPK (30+20+20 g $m^2$) in Zinnia, and Kumar *et al.*

(2002) in gladiolus. The findings of the above researchers confirm the results of current study.

*Total number of branches Plant⁻¹*

Significant difference was recorded among various fertilizer treatments on number of branches per plant. Higher number of branches (11.2) were recorded in plants treated with Nitrogen only and N+P. Control, N, K, P, N+P, N+K and N+P+K effect was significantly different from each other (Table 1).

**Table 1.** Effect of different combinations of N, P and K on plant height, number of branches/plant and number of suckers/plant in Chrysanthemum for year 1 (2010) and year 2 (2011).

| NPK combination | Plant height (cm) | | | Number of branches/plant | | | Number of suckers/plant | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | Mean | 2010 | 2011 | Mean | 2010 | 2011 | Mean |
| Control | 48.5c | 44.5 e | 46.5 d | 7.0 d | 7.3 c | 7.1 e | 7.5 f | 4.7 e | 6.1 e |
| Nitrogen | 57.9 ab | 56.3 bcd | 57.1 b | 10.8 b | 11.0 a | 10.9 a | 10.3 bc | 12.0 a | 11.2 a |
| Phosphorus | 50.7 c | 53.0 cd | 51.9 c | 9.7 c | 8.5 bc | 9.1 c | 8.5 e | 7.8 cd | 8.2 c |
| Potash | 48.7 c | 51.3 d | 50.0 cd | 7.9 d | 8.3 c | 8.1 d | 7.0 f | 7.3 d | 7.2 d |
| N+P | 62.1 a | 56.8 bcd | 59.4 b | 12.1 a | 10.3 a | 11.2 a | 12.0 a | 10.5 b | 11.3 a |
| N+K | 58.3 ab | 61.7 ab | 60.0 ab | 9.7 c | 10.3 a | 10.0 b | 9.8 cd | 9.2 bc | 9.5 b |
| P+K | 54.0 bc | 58.8 abc | 56.6 b | 9.5 c | 9.8 ab | 9.7 bc | 9.4 d | 9.7 b | 9.6 b |
| N+P+K | 64.2 a | 63.8 a | 63.9 a | 10.0 c | 10.0 a | 10.0 b | 10.5 b | 9.8 b | 10.2 b |
| LSD | *6.7(**)* | *6.3(**)* | 4.5(**) | *0.9(**)1* | *.4(**)* | 0.8(**) | *0.6(**)* | *1.4(**)* | 0.7(**) |
| *(p=0.05)* | | | | | | | | | |
| Year | | | | | | | | | |
| 2010 | -- | -- | 55.6 | -- | -- | 9.4 | -- | -- | 9.3 |
| 2011 | -- | -- | 55.8 | -- | -- | 9.6 | -- | -- | 9.0 |
| LSD (*p=0.05*) | -- | -- | NS | -- | -- | NS | -- | -- | NS |
| NPK x Year | | | | | | | | | |
| LSD *(p=0.05)* | | | NS | | | NS | | | NS |

Least significant differences (LSD) are used to compare treatment means within the column for the data pooled over two growing years 2010 and 2011; while LSD given in italics are used to compare treatment means within the columns for individual year.

NS = Non significant: * $p < 0.05$.

The plants in control produced less branches due to non availability of nutrients. This might have happened due to the reason that nitrogen is involved in the basic reaction of photosynthesis that resulted in more number of leaves and branches. The low C:N ratio also encourages vegetative growth (Hartmann *et al*., 1981). Being the constituent of protein and nucleic acid, Nitrogen is helpful in plant growth (Haque and Jakhro, 2001) and also promotes rapid growth (Javid *et al*., 2005). Phosphorus encourages cell wall and length of plant (Henry, 1982). These findings are in accordance with the findings of Ahmad *et al.* (2004) in chrysanthemum, Singh and Gupta, (1996) in dahlia and Belgaonkar *et al.* (1996) in chrysanthemum. Yassin and Pappiah, (1990) recorded maximum plant height and more number of branches per plant in chrysanthemum when applied nitrogen along with sheep manure. Rao *et al.* (1992) noticed an increase in number of lateral branches per plant with higher level of nitrogen in chrysanthemum.

*Total number of suckers plant⁻¹*

Various combinations of fertilizers had significant effect on number of suckers per plant. The total number of suckers (11.3) were recorded when nitrogen and phosphorus were applied to the plants as compared to control (6.1). The nitrogen only and plants treated with N+P produced similar number of suckers. The results on the total number of sucker varied for N+K, P+K and N+P+K (Table 1).

Higher number of suckers were recorded when nitrogen alone or in combination with Phosphorus or Potash was applied to the plants. Nitrogen is the most important plant nutrient as it is a constituent of protein and nucleic acid, which is extremely helpful in plant growth (Haque and Jakhro, 2001) and also promotes speedy vegetative growth. This is because of higher concentration of nitrogen, which has ability to increase leaf cell number and cell size with an overall increase in production Meyer *et al.* (1973). Nitrogen is a component of chlorophyll and is required for several enzyme reactions. These findings are in line with those of Patil, (1998) who recorded more number of suckers in daisy.

**Table 2.** Effect of different combinations of N, P and K on number of leaves/ plant and leaf area in Chrysanthemum for year 1 (2010) and year 2 (2011).

| NPK combination | Number of leaves/ plant | | | Leaf area (cm²) | | |
|---|---|---|---|---|---|---|
| | 2010 | 2011 | Mean | 2010 | 2011 | Mean |
| Control | 50 c | 44 d | 47 d | 99.1e | 89.2 c | 94.2 d |
| Nitrogen | 68 a | 75 a | 71 a | 135.3 a | 124.3 ab | 129.8 a |
| Phosphorus | 56 b | 57 c | 56 c | 123.7 bc | 117.8 b | 120.8 b |
| Potash | 47 c | 52 c | 50 d | 109.3 d | 101.2 c | 105.3 c |
| N+P | 50 c | 58 bc | 54 c | 135.5 a | 127.0 ab | 131.3 a |
| N+K | 60 b | 53 c | 57 c | 130.3 ab | 124.7 ab | 127.5 ab |
| P+K | 56 b | 53 c | 54 c | 120.1 c | 123.1 ab | 121.6 b |
| N+P+K | 69 a | 65 b | 67 b | 130.5 a | 132.7 a | 131.6 a |
| LSD*(p=0.05)* | *4.53(**)* | *5.19(**)* | 4.0(**) | *6.69(**)* | *13.3(**)* | 7.3(**) |
| Year | | | | | | |
| 2010 | -- | -- | 57 | -- | -- | 122.6 |
| 2011 | -- | -- | 57 | -- | -- | 117.9 |
| LSD (*p=0.05*) | -- | -- | NS | -- | -- | NS |
| Sowing Date x Year | | | | | | |
| LSD *(p=0.05)* | | | NS | | | NS |

Least significant differences (LSD) are used to compare treatment means within the column for the data pooled over two growing years 2010 and 2011; while LSD given in italics are used to compare treatment means within the columns for individual year.

NS = Non significant: * $p < 0.05$.

*Total number of leaves plant*$^{-1}$

The total number of leaves was higher (71) in plants treated with nitrogen only, while it was less (47) in control plants and plants treated with Potash (50) respectively. It was further indicated that control and potassium had similar effect on number of leaves. Nitrogen, Phosphorus, Potash and N+P+K were significantly different from each other.

It might be the reason that the plant height and number of branches were also increased when nitrogen alone or in combination with phosphorus and Potash was applied. The increased height and number of branches produced more vegetative buds and ultimately more leaves. Higher concentration of nitrogen has the ability to increase the number of cells in leaves, cell size and an overall leaf production. On the other hand, in control there were less number of leaves which might be due to the absence of nitrogen which initiates leaf buds. These findings are in close conformity with the findings of Ahmad *et al.* (2004) who recorded maximum (100) leaves per plant by applying Urea, DAP and Farm Yard Manure in combination in dahlia. Javid *et al.* (2005) found in

their study that NPK (30+20+20 g $m^2$) produced more leaves per plant in zinnia. Similar results were obtained by Sigedar *et al.* (1991) in calendula.

*Leaf area ($cm^2$)*

When nitrogen + phosphorus + potash or nitrogen and phosphorus were applied to the plants, it increased the leaf area (131.6 $cm^2$) and (131.3 $cm^2$) respectively as compared to control (94.2 $cm^2$). Significant difference was also observed when control, N, P, N+P, K, P+K and N+P+K as compared to control. Similarly potash and K+P were also statistically at par at 5% level of significance (Table 2). Higher leaf area was recorded when all three nutrients (N, P, K) were applied to the plant. Almost the same pattern was observed in treatment where nitrogen or nitrogen with phosphorus were applied to the chrysanthemum plants. Nitrogen helps in increasing vegetative growth by increasing leaf cell number and cell size (Meyer *et al.*, 1973) and ultimately increasing leaf area. Phosphorus is essential component of protoplasm and chlorophyll material, which causes the conversion of photosynthates in to phospholipids resulting in adequate vegetative growth. Similarly potash is important nutrient which helps in the synthesis of peptide bond, protein and carbohydrate metabolism, also causes cell division and metabolism (Belorkar *et al.* 1992). Phosphorus and potash along with nitrogen resulted in maximum increase in nutrient uptake due to increased photosynthesis, resulting in an increased leaf area. Hence application of all three nutrients resulted in larger leaf area.

**Table 3.** Effect of different combinations of N, P and K on days to flowering, number of flowers/plant and blooming period in Chrysanthemum for year 1 (2010) and year 2 (2011).

| NPK combination | Number of days to flowering | | | Number of flowers/ plant | | | Blooming period | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2010 | 2011 | Mean | 2010 | 2011 | Mean | 2010 | 2011 | Mean |
| Control | 131 ab | 126.6 bc | 129 b | 16 d | 13 d | 15 d | 33 e | 37 | 35 b |
| Nitrogen | 134 a | 135.9 a | 135 a | 27 b | 25 bc | 26 bc | 34 de | 36 | 35 b |
| Phosphorus | 124 c | 124.3 bcd | 124 cd | 28 ab | 30 ab | 29 ab | 36 cd | 38 | 37 ab |
| Potash | 127 bc | 123.8 cd | 126 bc | 21 c | 28 bc | 25 c | 39 ab | 34 | 36 ab |
| N+P | 126 bc | 130.2 ab | 128 bc | 32 a | 28 bc | 30 a | 40 a | 36 | 38 a |
| N+K | 125 c | 127.5 bc | 126 bc | 28 b | 24 bc | 26 bc | 38 bc | 39 | 38 a |
| P+K | 118 d | 124.1 bcd | 121 d | 27 b | 23 c | 25 c | 38 bc | 38 | 38 a |
| N+P+K | 114 d | 118.9 d | 116 e | 30 ab | 34 a | 32 a | 38 bc | 39 | 38 a |
| LSD *(p=0.05)* | *5.5(**)* | *6.2(**)* | 4.1(**) | *3.9(**)* | *5.6(**)* | 3.3(**) | *2.37(**)* | *NS* | 2.5(*) |
| Year | | | | | | | | | |
| 2010 | -- | -- | 125 | -- | -- | 27 | -- | -- | 37 |
| 2011 | -- | -- | 126 | -- | -- | 26 | -- | -- | 37 |
| LSD *(p=0.05)* -- | -- | | NS | -- | | NS | -- | | NS |
| Sowing Date x Year | | | | | | | | | |
| LSD *(p=0.05)* | | | NS | | | NS | | | NS |

Least significant differences (LSD) are used to compare treatment means within the column for the data pooled over two growing years 2010 and 2011; while LSD given in italics are used to compare treatment means within the columns for individual year.

NS = Non significant: * $p < 0.05$.

*Flowering Characteristics*

*Number of days to flowering*

The mean table 3.3 indicated that the number of days to flower were increased (135 days) with treatment of nitrogen only and decreased (116 days) with nitrogen+ phosphorus and potash treatment as compared to control (Table 3).

Plants took more days to flower when the nitrogen alone was applied. It might be the reason that the plants receiving N, P and K might have completed vegetative growth early due to balanced nutrition and also had sufficient food material to produce the flower earlier, while in treatments where nitrogen only or nitrogen and phosphorus were applied, took more days to flower which might be due to late emergence of flower buds. These findings are in close conformity with those reported by Mishra (1998) in gaillardia and Ahmad *et al.* (2004) recorded early flowering in dahlia by applying Urea, DAP and Farm Yard Manure in combination.

**Table 4.** Effect of different combinations of N, P and K on flower size and flower fresh weight in Chrysanthemum for year 1 (2010) and year 2 (2011).

| NPK combination | Flower size (cm) | | | Flower fresh weight (g) | | |
|---|---|---|---|---|---|---|
| | 2010 | 2011 | Mean | 2010 | 2011 | Mean |
| Control | 4.7 c | 4.3 e | 4.5 e | 3.3 d | 3.3 e | 3.3 d |
| Nitrogen | 5.2 b | 5.5 bc | 5.4 c | 3.6 c | 3.8 cd | 3.7 c |
| Phosphorus | 4.8 c | 5.1 cd | 4.9 d | 3.4 cd | 3.8 cd | 3.6 c |
| Potash | 4.7 c | 4.8 de | 4.7 de | 3.6 c | 3.5 de | 3.6 c |
| N+P | 5.3 b | 5.9 ab | 5.6 bc | 4.0 b | 4.1 bc | 4.0 b |
| N+K | 6.0 a | 6.2 a | 6.1 a | 4.3 a | 4.4 | 4.4 a |
| P+K | 6.0 a | 5.9 ab | 5.9 ab | 4.4 a | 4.2 ab | 4.3 a |
| N+P+K | 6.2 a | 6.4 a | 6.3 a | 4.4 a | 4.5 a | 4.4 a |
| LSD*(p=0.05)* | *0.4(**)* | *0.6(**)* | 0.4(**) | *0.3(**)* | *0.31(**)* | 0.18(**) |
| Year | | | | | | |
| 2010 | -- | -- | 5.4 | -- | -- | 3.9 |
| 2011 | -- | -- | 5.5 | -- | -- | 4.0 |
| LSD (*p=0.05*) | -- | -- | NS | -- | -- | NS |
| Sowing Date x Year | | | | | | |
| LSD *(p=0.05)* | | | NS | | | NS |

Least significant differences (LSD) are used to compare treatment means within the column for the data pooled over two growing years 2010 and 2011; while LSD given in italics are used to compare treatment means within the columns for individual year.

NS = Non significant: * $p < 0.05$.

*Total number of flowers plant$^{-1}$*

Total number of flowers per plant were increased (32) with N, P and K treatment as compared to control (15). Plants treated with control, potash, N+P, P+K and N+P+K were significantly different from each other, while potash and P+K were statistically similar in their effect.

As the number of branches were also higher in the treatments (N+P) and (N+P+K), that resulted in more photosynthesis and food accumulation, which might have resulted in better growth and converted photosynthates in to flower production and ultimately produced more number of flowers. De and Dhimon (1998) recorded maximum number of flowers per plant in chrysanthemum with the combination of 600 kg N and 200 kg $K_2O$/ ha. These results are also supported by those of Singh and Gupta (1995) in dahlia.

*Blooming period (Days)*

Various combinations of fertilizers had significant effect on blooming period (Table 3). Flower remained alive for significantly more days (38) when treated

with N+P+K as compared to control and those plants treated with nitrogen only where the flowers remained fresh for 35 days. The blooming period remained same when plants were treated with N+P, P+K, N+K and N+P+K. Similarly untreated plants and those plants treated with nitrogen were same in their effect regarding blooming period. Plants treated with phosphorus and potash also had similar effect on blooming period.

The blooming period was higher when plants were treated with all three nutrients(N+P+K), which might be due to synergistic effect of all three nutrients that after full bloom the plant supported with N, P and K was able to provide some food to the flower to sustain longer. The findings are in line with those of Monish *et al.,* (2008) in China aster. Mashaldi (2000) recorded maximum blooming period when applied 100 % recommended dose of N, P and K along with vermi-compost at 15 tonnes/ha in marigold.

*Flower size (cm)*

There was significant difference among various combinations of fertilizers regarding flower size (Table 4). Significantly larger flower size (6.3 cm) was recorded when plants were given N+P+K, while flowers were significantly smaller (4.5 cm) in control. There was significant difference in effects on flower size among control, Nitrogen, Phosphorus, N+K and N+P+K, while treatment N+K and N+P+K had statistically similar effects (Table 4).

The flower gained significant increase in size when the plant was applied with all three nutrients (N, P and K), while it was significantly smaller in control. It might be the reason that when all three elements were applied to the plant, it gained increased height, number of branches, number of leaves and large leaf area. It ultimately resulted in enhanced photosynthates to form early and large sized flowers. These findings are in conformity with the reports of Ahmed *et al.* (2004) who recorded increase in flower size when applied Urea, DAP and Farm Yard Manure in combination in dahlia and Javid *et al.* (2005) recorded big size flowers when applied NPK at (30+20+20 g $m^2$) in zinnia.

*Flower Fresh weight (g)*

Various combinations of fertilizers significantly affected the flower fresh weight, while it was not affected significantly by interactive effect of fertilizer and year. Flower fresh weight was greater (4.4 g) when N+P+K were applied to the plant, while it was minimum (3.3 g) in control. Control and N+P were significantly different from each other and other treatments, while the flower weight remained same in plants treated with N, P and K. Similarly the effects of N+K, P+K and N+P+K were also same (Table 4).

When N, P and K were applied alone the weight did not increase as small sized flowers were recorded. It might be the reason that when all three elements were applied to the plant, it gained increased height, number of branches, number of leaves and large leaf area. It ultimately might have resulted in enhanced photosynthates to form early and large sized flowers with greater weight. The flower fresh weight seems to be directly proportionate to the size of the flower. These findings are in conformity with the findings of Javid *et al.,* (2005) in zinnia.

*Conclusions and recommendations*

This study has highlighted the importance of balanced application of fertilizers for early flowering in chrysanthemum. It is necessary to apply the fertilizer that contains all three macro nutrients like N, P and K. Number of flowers, blooming period and flower size increased with the application of Nitrogen, Phosphorus and Potash in combination.

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