VI - SUMMARY & CONCLUSION

An investigation entitled "Effect of nitrogen, phosphorus and potash on the growth and flowering of African marigold (Tagetes erecta)" was carried out for two consecutive winter seasons viz., 2005-06 and 2006-07 as field experiment at Agricultural Research Farm of Amar Singh (P.G.) College, Lakhauti (Bulandshahr), U.P. The treatments included in this experiment consisted of four nitrogen levels viz., 0, 100, 150 and 200 kg/ha, four phosphorus levels i.e. 0, 60, 120 and 180 kg/ha and three potash levels viz., 0, 80 and 160 kg/ha, respectively. Thus, in all 48 treatment combinations were tested in factorial randomized block design with three replications.

The soil of both the experimental fields were low in nitrogen, medium in phosphorus and abundantly rich in potash content. The values for available nitrogen were 210.0 kg and 217.0 kg/ha and that for available phosphorus 21.60 kg and 23.40 kg ha⁻¹ during the year 2005-06 and 2006-07, respectively. While available potash in the year 2005-06 and 2006-07 were 232.0 kg and 240.0 kg/ha, respectively. The soil of the investigation fields have total nitrogen 0.042 (%) in the year 2005-06 and 0.044 (%) in the year 2006-07, respectively. The quantity of total potash was 0.282% in the first season and 0.306 % in the second season, respectively. Simultaneously, the pH values were 8.0 and 7.8 in the first and second season. Moreover, organic carbon
was recorded 0.39% in the year 2005-06 and 0.42% in the year 2006-07, respectively. During cropping period the total rainfall received in the second season was amounted 22.0 mm, while in the first season, it was only 11.0 mm.

6.1. Season:

The climatic conditions as prevailed in the second season were more conducive for growth and development point of view due to which performance of African marigold flowering crop was observed superior and production of flowers was found higher in the year 2006-07 than in the year 2005-06.

6.2. Nitrogen (kg/ha);

(i) Dose 200 kg N/ha produced highest crop stand / m² at 30 days and full blooming stage in both the seasons, however, minimum crop stand/m² was recorded under control in respective seasons. On the other hand plant height was noted highest with 150 kg N/ha at all the crop growth stages in both the seasons. Nitrogen dose beyond 150 kg/ha reduced height of the plant, though more dwarf plants were noted under control in both the seasons. Mean while spread of plants along and across the row were noted maximum with 200 kg N/ha while control plots showed lowest spread of plants along and across the row in respective seasons (Table, 4.3 and 4.4).
(ii) The results of the table (4.6, 4.7, 4.8 and 4.9) reveals that maximum no. of leaves on longest primary branch, diameter of main shoot, no. of primary and secondary branches plant\(^{-1}\) were recorded with 150 kg N/ha and noted lowest of these values with control at all the successive stages of growth in both the seasons.

(iii) Obviously, maximum dry matter accumulation/plant (g) was recorded with 150 kg N/ha while obtained lowest dry matter accumulation/plant (g) with control at all the successive stages of crop growth in both the seasons. Increasing nitrogen rates brought delayness in appearance of first flower bud (Table, 4.11), thus maximum delay in appearance of first flower bud viz., 59.31 days and 61.72 days in the first and second season was recorded with 200 kg N/ha. Though early appearance of first flower bud viz., 57.52 days and 60.13 days was accrued with control in the first and second season, respectively. On contrary, each increase in nitrogen application showed significant increase in no. of flower buds/plant over control, thus maximum no. of flower buds viz., 112.90 and 114.01 were recorded with 150 kg N/ha in the first and second season, respectively. Control plots showed lowest no. of flower buds viz., 110.80 and 111.10 in the first and second season, respectively (Table, 4.11).
(iv) Although, days to commencement of the first flower were increased with increasing nitrogen rates thus the early flowering was observed under control (65.71 days and 68.32 days in the first and second season), however, 200 kg N/ha gave highest delay in commencement of the first flowering viz., 67.51 days and 69.92 in the first and second season, respectively. Similarly, control also showed early colour break in the first flower bud (63.62 days in the first season and 66.22 days in the second season). However, each increase in nitrogen rates prolonged the duration of the colour break in first flower bud, therefore, dose 200 kg N/ha gave highest delay in colour break in first flower bud viz., 65.43 days in the year 2005-06 and 67.88 days in the year 2006-07, respectively (Table, 4.12). The results of the table (4.13) reveals that 150 kg N/ha gave highest no. of flowers/plant viz., 105.93 and 106.80 in the first and second season while control produced lowest no. of flowers/plant viz., 96.36 and 98.22 in the first and second season, respectively. Moreover, maximum flower size viz., 10.45 cm and 10.70 cm in the first and second season was followed by 150 kg N/ha, though control plots showed lowest flower size viz., 8.40 cm and 8.46 cm in the first and second season, respectively (Table, 4.13).

(v) Consequently, dose 200 kg N/ha gave highest length of the flower stalk viz., 7.62 cm and 8.22 cm in the first and second season, respectively,
whereas control produced lowest length of the flower stalk i.e. 6.61 cm and 6.74 cm in the first and second season, respectively. On the other hand 150 kg N/ha gave maximum weight of flower heads i.e. 469.70 g and 496.20 g/plant in the year 2005-06 and 2006-07, respectively (Table, 4.14). Mean while control gave lowest weight of the flowers/plant viz., 380.30 g and 392.10 g in the year 2005-06 and 2006-07, respectively.

(vi) Maximum flower yield was recorded with 150 kg N/ha i.e. 339.32 q and 342.52 q/ha in the first and second season, respectively. Nitrogen dose 200 kg/ha was observed superior than 100 kg N/ha from flower yield (q/ha) point of view. Usually, maximum shoot yield viz., 475.04 q/ha in the year 2005-06 and 513.77 q/ha in the year 2006-07 was also recorded with 150 kg N/ha, though control plots produced lowest flower yield (278.41 q and 281.32 q/ha in the first and second season) and shoot yield (389.78 q and 421.96 q/ha in the first and second season, respectively (Table, 4.15).

(vii) An examination of the data of table (4.16) showed that longevity of the flowers due to 150 kg N/ha significantly increased over 0 and 100 kg N/ha. The more duration of freshness i.e., 9.41 days and 9.56 days in the first and second season were showed by 150 kg N/ha. On contrary, nitrogen dose 200 kg/ha increased days to first picking of
flowers as compared to 0, 100 and 150 kg N/ha. The highest days required to first picking of flowers viz., 113.80 days and 114.90 days in the first and second season was recorded with 200 kg N/ha. Moreover, control gave lowest longevity of the flowers viz., 5.05 days and 5.22 days in the first and second season, however, minimum days required to first picking of the flowers viz., 108.40 days and 108.80 days in the first and second season was also recorded with control.

(viii) A present study given in table (4.17) showed that nitrogen content (%) in plants was generally observed higher at floral bud initiation stage as compared to at full bloom and fading of flowers stage in both the seasons. Nitrogen dose 200 kg/ha gave highest nitrogen content (%) in plants at floral bud initiation stage viz., 0.943% in the year 2005-06 and 0.944% in the year 2006-07, respectively which was noticeably superior to 0, 100 and 150 kg N/ha. Though control produced lowest nitrogen content viz., 0.911% and 0.914% in the first and second season at floral bud initiation stage. Similar trend pertaining to nitrogen content (%) in plants at full bloom stage and fading of flowers stage was observed just as to that of nitrogen content at floral bud initiation stage during both the seasons.

(ix) The results summarized in the table (4.18) reveals that 150 kg N/ha gave highest phosphorus content in plants at floral bud initiation stage viz., 0.1828% and 0.2026% in the first and second season, respectively
while lowest of these values were noted at control (0.1642% and 0.1653% in the first and second season). Similar trend was observed to phosphorus content (%) in plants at fading of flowers stage as to that of initiation of floral bud stage during both the seasons.

Treatment 150 kg N/ha gave highest potassium content (%) in plants at initiation of floral bud stage (0.115% in the year 2005-06 and 0.172% in the year 2006-07) and at full bloom stage (0.115% in the year 2005-06 and 0.117% in the year 2006-07). Subsequently, control showed lowest potassium content (%) in plants at initiation of floral bud stage (0.146% and 0.152% in the first and second season) and full blooming stage (0.103% and 0.105% in the first and second season). On the other hand potassium content (%) in plant at fading of flowers stage was significantly increased up to use of 200 kg N/ha over control in both the seasons. Thus, maximum potassium content (%) in plants at fading of flowers stage viz. 0.057% and 0.062% were perceived with 200 kg N/ha in the first and second seasons, respectively. The lowest potassium content (%) in plants at fading of flowers stage were recorded under control (0.048% and 0.049% in the first and second season) table 4.19.

(xi) The results summarized in table (4.20) depicted that N, P and K content (%) in whole plant was noted higher with 150 kg N/ha while beyond it N, P and K content (%) in whole plant was decreased in
both the seasons. Though minimum N, P and K content (%) in plant was recorded under control in both the years.

(xii) Maximum nitrogen, phosphorus and potash uptake through whole plant viz., 388.45 kg and 464.11 kg/ha, 420.21 kg and 502.64 kg/ha and 250.01 kg and 301.41 kg/ha in the first and second season were recorded with 150 kg N/ha however, control plots gave lowest uptake of N, P and K viz., 289.33 kg and 324.92 kg/ha, 307.38 kg and 334.06 kg/ha and 191.77 kg and 220.83 kg/ha in the first and second season, respectively through African marigold crop plants (Table, 4.21).

(xiii) From the net return point of view treatment 150 kg N/ha noted superior than 0, 100 and 200 kg N/ha which gave highest net return of Rs. 102617.90/ha. The lowest net return of Rs. 78797.90/ha was accrued with control on pooled data basis. (Table 4.22).

6.3 Phosphorus:

(i) An examination of the results of the table (4.1) showed that 180 kg P<sub>2</sub>O<sub>5</sub>/ha produced maximum crop stand/m<sup>2</sup> at 30 days and at full blooming stage during both the seasons. Though control gave lowest crop stand/m<sup>2</sup> at 30 days and at full blooming stage during both the seasons. Similarly 180 kg P<sub>2</sub>O<sub>5</sub>/ha gave highest plant height (cm) and spread of plant (cm) along the row at all the successive stages of crop
growth during both the seasons. While control showed lowest plant height (cm) and plant spread (cm) along the row at all the successive stages during both the years.

(ii) Obviously, results of the present investigation given in table (4.4, 4.6, 4.7, 4.8, 4.9 and 4.10) clearly showed that maximum spread of plant across the row (cm), no. of leaves on longest primary branch/plant, diameter of the main shoot (cm), no. of primary branches/plant, no. of secondary branches/plant and drymatter accumulation/plant were recorded with 120 kg P$_2$O$_5$/ha at all the successive stages of crop growth during both the seasons. Meanwhile control plots produced lowest of these values of the above characters at all the successive stages of crop growth during both the years.

(iii) The results of the table (4.11) indicated that phosphorus rates reduced days to appearance of first flower bud, thus, dose 180 kg P$_2$O$_5$/ha exhibited quickest appearance of first flower bud viz., 57.72 days in the first season and 60.22 days in the second season which were less than the other applied phosphorus rates, while control plots taken more days for appearance of first flower bud viz., 59.55 days in the first year and 62.84 days in the second year, respectively. Subsequently, dose 120 kg P$_2$O$_5$/ha produced maximum no. of floral buds viz., 113.10 and
114.01 per plant in the first and second season however, control showed lowest no. of flower buds/plant i.e. 110.40 in the year 2005-06 and 112.30 in the year 2006-07, respectively.

(iv) A phosphorus dose 180 kg/ha gave highest reduction in days to commencement of the first flowering viz., 65.93 days and 68.45 days in the first and second season whereas more days required to commencement of first flowering viz., 67.72 days in the first season and 71.08 days in the second season under control. Simultaneously, phosphorus rates also decreased days to colour break in the first flower bud as compared to control, thus dose 180 kg P₂O₅/ha showed highest reduction in days to colour break in the first flower bud viz., 63.76 days and 66.43 days in the first and second season, respectively. Maximum days viz., 65.68 and 68.98 in the first and second season were taken for colour break in the first flower bud under the control (Table, 4.12).

(v) Maximum no. of flowers/plant viz., 106.66 and 106.80 in the first and second season and size of flower viz., 10.45 cm and 10.84 cm in the first year and second year were produced by 120 kg P₂O₅/ha however, control produced lowest no. of flowers/plant (96.63 and 98.62) and size of flower (8.30 cm and 8.32 cm) during the year 2005-06 and 2006-07, respectively (Table, 4.13).
(vi) The results of the table (4.14) reveals that phosphorus dose 180 kg/ha produced maximum length of the flower stalk viz., 7.81 cm in the first season and 8.24 cm in the second season, respectively though control showed lowest length of the flower stalk viz., 6.51 cm and 6.72 cm in the first and second season, respectively. On contrary, weight of flowers/ plant found maximum viz., 470.90 g and 504.40 g in the first and second season with the use of 120 kg P₂O₅/ha, while lowest weight of the flowers/ plant such as 381.10 g and 388.80 g in the year 2005-06 and 2006-07 was accrued under control plots.

(vii) A phosphorus dose 120 kg/ha gave highest flower yield viz., 333.92 q/ha in the year 2005-06 and 338.32 q/ha in the year 2006-07, respectively, though control plots gave lowest flower yield viz., 282.12 q and 284.22 q/ha in the year 2005-06 and 2006-07, respectively. Similarly, 120 kg P₂O₅/ha gave highest shoot yield i.e. 467.48 q and 507.47 q/ha in the first and second season respectively, whereas control produced lowest shoot yield viz., 394.98 q/ha in the first year and 426.32 q/ha in the second year, respectively (Table 4.15).

(viii) Table (4.16) reveals that dose 120 kg P₂O₅/ha showed maximum longevity of the flowers i.e. 9.50 days and 9.53 days in the first and second season, however, control gave lowest longevity of the flowers viz., 5.12 days in the first year and 5.24 days in the second year. On
contrary increasing phosphorus rates decreased days to first picking of the flowers, therefore, dose 180 kg/ha gave highest reduction in duration of the first picking of the flowers viz., 108.60 days in the first season and 108.70 days in the second season, respectively. Moreover control showed more days to first picking of the flowers viz., 113.20 days in the year 2005-06 and 115.40 days in the year 2006-07, respectively.

(ix) Nonetheless dose 180 kg P₂O₅/ha gave maximum N, P and K content (%) in plants at initiation of floral bud stage, full blooming stage and fading of flowers stage during both the seasons. Though control showed lowest N, P and K content (%) at initiation of floral bud stage, at full blooming stage and fading of flowers stage during both the year (Table 4.17, 4.18 & 4.19).

(x) Maximum nitrogen content in whole plant (0.475% and 0.527%) and potash content (0.310% and 0.346%) in the first and second season were recorded with 120 kg P₂O₅/ha, whereas control produced lowest nitrogen content (0.428% and 0.471%) and potash content (0.288% and 0.315%) in the whole plant during the year 2005-06 and 2006-07, respectively. On the other hand dose 180 kg P₂O₅/ha produced highest phosphorus content in whole plant viz., (0.601% and 0.666% in the first and second season, respectively though control showed lowest phosphorus content in whole plant viz., 0.369% and 0.417% in the first and second season, respectively (Table, 4.20).
(xi) The results of the table (4.21) showed that dose 120 kg P<sub>2</sub>O<sub>5</sub>/ha gave highest nitrogen uptake (380.67 kg and 445.73 kg/ha in the first and second season) and potash uptake (248.43 kg and 292.61 kg/ha in the first and second season) by whole plant. Meanwhile control provided lowest nitrogen uptake (289.80 kg and 334.66 kg/ha in the first and second season) and potash uptake (195.01 kg and 223.82 kg in the year 2005-06 and 2006-07, respectively) by whole plant. On contrary, phosphorus dose 180 kg/ha gave highest phosphorus uptake (467.92 kg and 545.65 kg/ha in the first and second season) by whole plant. Although control plots gave lowest phosphorus uptake (263.39 kg and 296.30 kg/ha in the first and second season) by whole plant.

(xii) Maximum net income of Rs. 100817.90/ha was accrued with 120 kg P<sub>2</sub>O<sub>5</sub>/ha while lowest net income of Rs. 80357.90/ha was produced by control through African marigold crop on pooled data basis in the present investigation (Table 4.22).

6.4 Potash:

(i) The results summarized in table (4.1) showed that dose 160 kg K<sub>2</sub>O/ha gave highest crop stand/m<sup>2</sup> at 30 days and at full bloom stages during both the seasons, while control plots showed lowest crop stand/m<sup>2</sup> at 30 days and at full bloom stage during both the years. Simultaneously, maximum taller plants were recorded with 160 kg K<sub>2</sub>O/ha at all the successive stages of crop growth during both the seasons. Minimum dwarf plants were produced by control at all the successive stages of crop growth during both the seasons.
(ii) The results presented in table (4.3, 4.4, 4.6, 4.7, 4.8, 4.9 and 4.10) reveals that potash dose 160 kg/ha gave highest spread of plant along and across the row (cm), no. of leaves on longest primary branch/plant, diameter of the main shoot (cm), no. of primary and secondary branches/plant and drymatter accumulation/plant (g) at all the successive stages of crop growth during both the seasons. Subsequently control plots gave lowest spread of plants along and across the row (cm), no. of green leaves on longest primary branches/plant, diameter of the main shoot (cm), no. of primary and secondary branches/plant and drymatter accumulation/plant (g) at all the successive stages of crop growth during both the seasons.

(iii) Increasing potash rates delayed the appearance of first flower bud due to which highest days required to appearance of first flower bud viz., 59.68 days in the first season and 63.55 days in the second season were showed by 160 kg K₂O/ha, however, earliest appearance of first flower bud viz., 57.64 days and 59.63 days in the first and second season was showed by control. Maximum no. of flower buds/plant i.e. 114.20 and 114.55 in the first and second season was produced by 160 kg K₂O/ha, though control gave lowest no. of flower buds/plant viz., 110.10 and 111.02 in the first and second season, respectively (Table, 4.11).

(iv) Potash dose 160 kg/ha showed highest delay in the days to commencement of first flowering (67.84 days and 71.70 days) and
days to colour break in first flower bud (65.70 days and 69.66 days) in the first and second season, respectively. It is obvious from the table (4.12) that the earliest emergence of first flowering (65.84 days and 67.83 days) and colour break in first flower bud (63.78 days and 65.78 days) in the first and second season was produced by control.

(v) A perusal of the results of the table (4.13) depicted that dose 160 kg K₂O/ha showed maximum no. of flowers/plant viz., 105.76 and 106.56 and size of flower head viz., 10.70 cm and 11.04 cm in the first and second season, respectively. Control plots gave lowest no. of flower buds (96.13 and 98.80/plant) and size of flower head (8.15 cm and 8.12 cm) in the first and second season, respectively.

(vi) Maximum length of the flower stalk (7.60 cm and 8.02 cm) and weight of the flowers/plant (464.55 g and 492.90 g) in the first and second season, respectively was followed by 160 kg K₂O/ha however, minimum length of the flower stalk (6.81 and 6.90 cm) and weight of the flowers/plant (385.50 g and 391.20 g) in the first and second season, respectively was produced by control (Table 4.14).

(vii) An examination of the results of the table (4.15) reveals that potash dose 160 kg/ha gave highest flower yield (338.82 q and 339.20 q/ha) and shoot yield (460.36 q and 502.08 q/ha) in the first and second season, respectively. While control showed lowest flower yield (283.6 q and 284.76 q/ha) and shoot yield (397.08 q and 427.08 q/ha) in the year 2005-06 and 2006-07, respectively.
(viii) The results of the present investigation summarized in the table (4.16) showed that potash dose 160 kg/ha gave highest longevity of the flowers (9.45 days and 9.77 days) and days to first picking of flowers (113.40 days and 114.35 days) in the first and second year. Meanwhile control gave lowest length of the flower stalk (5.08 cm and 5.35 cm) and earliest first picking of the flowers (108.35 days and 109.80 days) in the first and second season, respectively.

(ix) An examination of the results of the table (4.17, 4.18 and 4.19) showed that 160 kg K₂O/ha gave highest N, P and K content (%) in plants at initiation of flower bud stage, at full blooming stage and at fading of flowers stage during both the years. The minimum N, P and K content (%) in plants at initiation of flower bud stage, at full blooming stage and at fading of flowers stage was produced by control during both the seasons.

(x) Maximum N, P and K content (%) in whole plant viz., 0.465% and 0.521%, 0.632% and 0.652% and 0.300% and 0.346% in the first and second season was produced by 160 kg K₂O/ha. Apparently control possessed lowest N, P and K content (%) in whole plant viz., 0.444% and 0.481%, 0.364% and 0.447% and 0.292% and 0.314% in the first and second season, respectively (Table, 4.20).

(xi) A potash dose 160 kg/ha produced highest nitrogen uptake (371.61 kg and 438.31 kg/ha), phosphorus uptake (505.07 kg and 548.51 kg/ha) and potash uptake (239.75 kg and 291.08 kg/ha) during the year 2005-
06 and 2006-07, respectively. Nevertheless control produced lowest nitrogen uptake (302.24 kg and 342.40 kg/ha), phosphorus uptake (247.78 kg and 318.19 kg/ha) and potash uptake (198.76 kg and 223.52 kg/ha) through whole plant during the first and second season, respectively (Table, 4.21).

(xii) An investigation reported in table (4.22) showed that potash dose 160 kg/ha gave highest net return of Rs. 100,548.15/ha while control produced lowest net return of Rs. 80,757.90/ha from African marigold cut flowering crop on pooled data basis.

Conclusion:

In the light of the present study results summarized above showed that 150 kg N/ha gave precise increase in addition to growth, flowering, yield, nutrients content, nutrients uptake and net return/ha as compared to 0, 100 and 200 kg N/ha. Simultaneously phosphorus dose 120 kg/ha showed sustainable increase pertaining to growth, flowering, yield, nutrients content, nutrients uptake except phosphorus and net income/ha than that of 0, 60 and 180 kg P$_2$O$_5$/ha. It is worth considering that 160 kg K$_2$O/ha produced tremendous increase in the growth, flowering, yield, nutrients content, nutrients uptake and net return/ha over 80 kg K$_2$O/ha and control. Further results of the present study reveals that for obtaining hand some income through African marigold crop, the crop should be grown by using 150 kg N/ha, 120 kg P$_2$O$_5$/ha and 160 kg K$_2$O/ha during winter season under the agroclimatic conditions of Western Uttar Pradesh.