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# EFFECT OF GROWTH REGULATORS ON SEED YIELD AND SEED QUALITY IN VARIETIES OF MUNGBEAN (*Vigna radiata* (L) Wilczek)

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## ABSTRACT

**A field experiment was conducted during summer season 2012 and 2013 at the research farm R.B.S. college Agra, U.P., to find out the effect of different levels of growth regulator on number of leaves, seed yield/plant, harvest index and other characters of Pant mung-5, K-851, SML-668 and Pusa-9072 varieties of mungbean. The application of GA treatment at $10^{-1}$ dose gave the comparatively higher in case of leave/plant, number of flower dropped/plant and plant biomass were observed in both the years. Mostly experimental varieties showed better performance of number of days of flower initiation and number of flowers/plant was recorded at dose $10^{-1}$ of treatment $10^{-1}$ and $10^{-3}$. The IAA treatment was found superior at dose $10^{-3}$ in respect of Pant mung-5 and K-851 with days of pod maturity. The significant difference was observed in SML-668 and P-9072 with days maturity of GA at dose $10^{-3}$ and BA at dose $10^{-3}$ respectively, in both the years. The maximum seed yield/plant recorded by Pant mung-5 and P-9092 under TIBA treatment dose $10^{-3}$ and other treatments and varieties were found susceptible at said condition be said that maximum seed yield/plant was showed by variety Pant mung-5 under 2,4-D at $10^{-3}$ and BA dose $10^{-3}$ gave the minimum seeds yield/ plant by of plant mung-5, SML-668 and K-851.**

***Key words :*** *growth regulator, seed yield and harvest index.*

India is the largest pulses producing country in the world. Pulses are mainly grown in rainfed area. Mungbean (*Vigna radiata* L.) is considered as one of the most important pulse crop in India. It is important legume crop characterized by a relative high content of protein (22%) and short summer season crop. It is one of important pulse crop cultivated in India ranking third having about 70% of the world area and 45% of production. In India area occupied by mungbean is about 23.63 million ha. with total production of 14.56 million tones but average productivity (625 kg/ha) is quite low. The various application of optimum quantity of growth regulators play an important role in high seed yield/plant and harvest index in mungbean (1, 2). The remarkable research work has not been conducted under arid, semi arid and rainfed conditions to find out the proper doses of growth regulator application for getting high plant biomass, harvest index and seed productivity in mungbean. Keeping in view the above facts the present study was under taken to find out the effect of application of growth regulator on plant biomass, harvest index and seed productivity and other characters in different varieties of mungbean viz.- Pant mung-5, K-851,SML-668 and Pusa-9072 under Agra region.

## MATERIALS AND METHODS

A field experiment was conducted during summer season 2012 and 2013 at the research farm R.B.S. college Agra, U.P., to find out the effect of four levels viz, control, $10^{-1}$, $10^{-2}$, $10^{-3}$of growth regulators on number of leaves/plant, number of days of flower initiation, number of flowers/plant, number of flowers dropped, days of pods maturity, seed yield/plant, plant biomass and harvest index of four varieties viz, Pant mung-5, K-851,SML-668 and Pusa-9072 of mungbean. Agra is situated at $27^0$ 11'0" N and $78^0$1'0" E longitude at an altitude of 171m above mean sea level and has a subtropical climate with dry hot summers and cold winters. The mean maximum temperature during the hottest month (June) ranges between 41-48°C, while mean minimum temperature in the coldest months (December-January) ranges between 2-8°C. Of the average annual rainfall of 695 mm, about 88% is received between June and October and the rest during winters. The experimental design was factorial randomized block with three replications. Urea was the source of nitrogen and the source of sulphur was gypsum while triple super-phosphate was used as source of phosphorus but in case of Potash in soil was rich. Observations were recorded time to time on number of leaves/plant, number of days of flower initiation, number of flowers/plant, number of flowers dropped, days of pods maturity, seed yield/plant, plant biomass and harvest index. The data collected in the experiment for different characters were subjected to statistical test for significance and analysis of variance. Critical difference (CD) values at 5% probability level were computed for making comparisons between treatments. Association between yield and its contributing characters were determined by multiple correlations method and the dependence of yield on its important contributing morphological characters were also determined by the multiple regression method suggested by (3).

## RESULTS AND DISCUSSION

**Number of leaves/plant :** The results presented in table 1a and 1b showed that In case of variety P-9072 and Pant mung-5 the dose $10^{-1}$ of GA, IAA and BA increased significantly the number of leaves as compared to other doses of the same growth regulator. GA at all doses increased significantly the number of leaves/plant as compared to the corresponding doses of IAA and BA except in variety P-9072 in 2013.GA and IAA were induced more number of leaves/plant at doses of $10^{-1}$ and $10^{-2}$ as compared to control. BA at doses $10^{-1}$ and $10^{-2}$ were almost at par with control. In case of TIBA and 2,4-D dose $10^{-3}$ induced significantly more number of leaves/plant as compared to the control and other doses of the same growth regulators. 2,4-D induced, in general, more number of leaves as compared to TIBA in Pant mung-5. However, the numbers of leaves/plant were more in GA and IAA. In case of varieties SML-668 and K-851 all the growth regulators behaved the same way as in the varieties P-9072 and Pant mung-5. The quantum of number of leaves was much higher in case of GA and IAA whereas it was lower in case of 2,4-D and TIBA. These findings are in concordance with the reports of (4). These results indicate that 2,4-D and TIBA did not encourage the vegetative growth because the number of leaves were less in plants treated with these growth regulators. Whereas GA and IAA did encourage the number of leaves as these were significantly higher as compared to other growth regulators and the control. This behavior is on the expected lines because 2,4-D and TIBA are growth retardants whereas IAA and GA are known growth promoters. Similar findings were reported by (5).

**Number of days of flower initiation :** It is revealed from table-1a and 1b that in varieties K-851 and SML-668 in both the years, there was significant increase or decrease in the number of days to flower initiation at various doses between the growth regulators used and compared to control. In general, the lowest dose of $10^{-3}$ of both TIBA and 2,4-D took least number of days to flower initiation as compared to other doses significantly. In case of GA and IAA the dose of $10^{-3}$ took maximum number of days as compared to the other doses of the same growth regulators. In case of varieties Pant mung-5 and P-9072 the behaviour of all the growth regulators was same but the differences were significant in increasing or decreasing the number of days taken to flower initiation. Least number of days were taken by 2,4-D than TIBA at the dose of $10^{-3}$ as compared to other growth regulators at all the doses The results are in agreement with those obtained by (6) who reported that the 2,4-D and TIBA seed treatments induced early flowering as compared to other growth regulators.

**Number of days of flower/plant :** In table 1a and 1b it was observed that the plants treated with GA and IAA had more number of flowers than the plants treated with TIBA, 2,4-D and the control though statistically the differences were significant in case of varieties K-851 and SML-668. On the other hand, the differences were also significant in varieties Pant mung-5 and P-9072. In these varieties significantly less number of flowers were observed in plants treated with TIBA as compared to even 2,4-D except Pant mung-5 in 2013. In case of both TIBA and 2.4-D, the dose of $10^{-1}$ induced least number of flowers. In Pant mung-5 and P-9072 at control had significantly more number of flowers as compared to BA, TIBA and 2,4-D at all doses except Pant mung-5 in 2013, whereas GA and IAA treated plants had significantly more number of flowers at all doses. Similar findings were reported by (4).

**Number of days of flower dropped :** The results presented in Table-1a and 1b the in case of varieties K-851 and SML-668 the growth regulators induced significant reduction in the number of flower dropped at all doses. In case of GA and IAA, the flowers dropped were more as compared to control and were less the plants treated with TIBA and 2,4-D at all doses. In case of varieties SML-668 and K-851 BA at all doses

**Table-1a**: Effect of growth regulators priming on numbers of leaves per plant, number of flowers per plant and some other traits in mungbean in years (2012).

| Growth Regulators | Doses | No. of leaves/ plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers dropped | No. of leaves/ plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers dropped | No. of leaves /plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers dropped | No. of leaves /plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers drop-ped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pant mung-5 | | | | SML-668 | | | | P-9072 | | | | K-851 | | | |
| Control | | 18.00 | 47.67 | 145.00 | 103.00 | 16.33 | 49.67 | 134.00 | 104.00 | 22.33 | 50.33 | 165.00 | 106.00 | 15.00 | 51.67 | 134.00 | 86.67 |
| GA | $10^1$ | 24.33 | 61.33 | 185.67 | 131.50 | 22.89 | 49.33 | 169.33 | 119.40 | 23.25 | 62.67 | 210.67 | 128.00 | 25.67 | 51.00 | 164.33 | 107.00 |
| GA | $10^2$ | 21.92 | 64.33 | 187.17 | 136.83 | 21.78 | 52.00 | 159.27 | 109.97 | 22.92 | 65.33 | 200.33 | 128.00 | 23.78 | 53.33 | 154.27 | 98.60 |
| GA | $10^3$ | 20.17 | 65.00 | 183.67 | 136.67 | 20.89 | 55.33 | 152.67 | 106.23 | 21.58 | 66.67 | 190.27 | 128.27 | 21.11 | 53.67 | 144.67 | 92.33 |
| BA | $10^1$ | 20.08 | 58.67 | 93.67 | 46.67 | 19.78 | 50.67 | 149.00 | 107.33 | 21.17 | 62.67 | 78.33 | 26.67 | 17.57 | 48.67 | 140.00 | 91.47 |
| BA | $10^2$ | 18.00 | 60.33 | 91.33 | 50.67 | 18.78 | 52.33 | 141.67 | 104.50 | 20.25 | 54.00 | 89.03 | 35.77 | 18.56 | 49.33 | 138.67 | 93.33 |
| BA | $10^3$ | 17.58 | 62.33 | 89.17 | 44.83 | 18.33 | 53.33 | 129.33 | 92.53 | 19.00 | 65.00 | 85.13 | 38.00 | 14.67 | 50.67 | 130.33 | 86.07 |
| IAA | $10^1$ | 23.17 | 63.67 | 191.33 | 133.10 | 22.67 | 49.67 | 176.17 | 129.93 | 22.17 | 66.00 | 200.17 | 123.00 | 25.78 | 51.33 | 167.17 | 117.90 |
| IAA | $10^2$ | 19.33 | 65.00 | 186.80 | 127.47 | 22.44 | 50.33 | 171.17 | 123.73 | 21.33 | 66.00 | 148.40 | 78.17 | 22.00 | 52.00 | 146.03 | 98.80 |
| IAA | $10^3$ | 17.92 | 66.33 | 179.00 | 126.73 | 21.89 | 51.33 | 161.03 | 115.37 | 20.25 | 60.33 | 170.67 | 106.33 | 20.44 | 54.00 | 134.67 | 88.00 |
| TIBA | $10^1$ | 20.25 | 53.00 | 79.00 | 22.77 | 13.44 | 47.00 | 119.17 | 70.90 | 19.67 | 52.67 | 80.67 | 10.03 | 14.00 | 50.33 | 96.17 | 35.00 |
| TIBA | $10^2$ | 21.08 | 54.67 | 75.13 | 15.47 | 14.11 | 48.33 | 122.03 | 70.60 | 20.08 | 54.67 | 100.27 | 27.60 | 14.33 | 48.00 | 109.03 | 46.37 |
| TIBA | $10^3$ | 21.75 | 52.33 | 77.00 | 11.00 | 15.22 | 45.00 | 129.17 | 73.43 | 21.50 | 54.00 | 95.00 | 14.67 | 15.11 | 47.33 | 116.13 | 51.87 |
| 2,4-D | $10^1$ | 20.31 | 51.67 | 74.67 | 23.47 | 13.05 | 48.67 | 94.67 | 52.67 | 20.30 | 53.67 | 92.33 | 23.17 | 14.21 | 44.00 | 106.00 | 41.00 |
| 2,4-D | $10^2$ | 21.40 | 51.00 | 81.07 | 14.70 | 13.88 | 47.33 | 102.00 | 50.33 | 19.56 | 52.00 | 110.67 | 33.50 | 14.87 | 47.00 | 114.33 | 47.90 |
| 2,4-D | $10^3$ | 22.09 | 50.00 | 83.33 | 4.17 | 15.40 | 46.33 | 110.33 | 48.67 | 20.60 | 51.07 | 115.00 | 30.33 | 15.42 | 46.00 | 118.67 | 50.00 |
| CD at 5% | | 0.42 | 1.876 | 5.02 | 3.93 | 0.33 | 0.826 | 4.88 | 5.33 | 0.37 | 1.165 | 4.87 | 10.95 | 0.28 | 1.32 | 5.07 | 3.84 |

**Table-1b :** Effect of growth regulators priming on seed numbers of leaves per plant, number of flowers per plant and some other traits in mungbean in years (2013).

| Growth Regulators | Doses | No. of leaves/ plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers dropped | No. of leaves/ plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers dropped | No. of leaves /plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers dropped | No. of leaves /plant | No. of days of flower initiation | No. of flower/ plant | No. of flowers drop-ped |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pant mung-5 | | | | SML-668 | | | | P-9072 | | | | K-851 | | | |
| Control | | 20.92 | 49.67 | 135.67 | 106.33 | 15.78 | 51.67 | 143.00 | 106.00 | 22.00 | 52.33 | 170.00 | 108.00 | 18.44 | 56.67 | 139.00 | 90.67 |
| GA | $10^1$ | 23.17 | 63.33 | 164.67 | 135.53 | 22.33 | 50.33 | 174.33 | 122.07 | 23.83 | 63.33 | 213.67 | 130.00 | 26.78 | 55.00 | 169.33 | 110.00 |
| GA | $10^2$ | 22.75 | 67.33 | 155.30 | 140.83 | 20.22 | 56.00 | 165.27 | 112.98 | 55.50 | 66.33 | 203.33 | 130.00 | 21.33 | 58.33 | 15837 | 99.60 |
| GA | $10^3$ | 21.08 | 69.00 | 149.23 | 139.67 | 19.00 | 59.33 | 156.67 | 108.23 | 21.17 | 64.67 | 144.27 | 131.27 | 20.00 | 59.67 | 148.67 | 95.33 |
| BA | $10^1$ | 18.67 | 60.67 | 144.67 | 50.67 | 13.56 | 52.67 | 153.00 | 110.33 | 22.17 | 3.67 | 92.33 | 30.67 | 16.89 | 50.67 | 145.00 | 93.47 |
| BA | $10^2$ | 17.92 | 62.33 | 140.57 | 53.67 | 13.22 | 53.33 | 145.67 | 107.50 | 21.17 | 65.00 | 91.03 | 38.77 | 18.44 | 52.33 | 144.67 | 46.33 |
| BA | $10^3$ | 17.58 | 64.33 | 131.70 | 47.83 | 15.11 | 55.33 | 132.33 | 96.53 | 20.25 | 66.00 | 87.13 | 41.00 | 18.89 | 53.67 | 135.33 | 89.07 |
| IAA | $10^1$ | 21.25 | 66.67 | 176.20 | 137.10 | 19.44 | 54.67 | 183.17 | 131.93 | 23.33 | 68.00 | 204.17 | 125.00 | 23.67 | 55.33 | 170.17 | 121.90 |
| IAA | $10^2$ | 19.50 | 69.00 | 159.13 | 131.47 | 17.22 | 57.33 | 174.17 | 127.73 | 22.83 | 68.00 | 152.40 | 81.17 | 20.89 | 57.00 | 150.06 | 100.80 |
| IAA | $10^3$ | 18.08 | 70.33 | 148.0 | 130.73 | 16.67 | 58.33 | 166.03 | 118.37 | 21.42 | 61.33 | 175.67 | 109.33 | 19.67 | 60.00 | 140.67 | 91.00 |
| TIBA | $10^1$ | 19.42 | 57.00 | 109.53 | 25.80 | 11.89 | 47.00 | 123.13 | 73.90 | 20.73 | 56.67 | 83.67 | 13.03 | 16.44 | 53.33 | 100.17 | 38.00 |
| TIBA | $10^2$ | 14.58 | 58.67 | 118.70 | 18.47 | 12.56 | 49.33 | 126.03 | 72.60 | 21.58 | 59.64 | 104.27 | 31.60 | 17.11 | 49.00 | 112.63 | 50.37 |
| TIBA | $10^3$ | 20.08 | 56.33 | 127.20 | 14.00 | 13.33 | 46.00 | 131.17 | 76.93 | 21.92 | 58.00 | 98.00 | 20.67 | 17.56 | 48.33 | 120.13 | 54.87 |
| 2,4-D | $10^1$ | 19.75 | 55.67 | 105.36 | 26.13 | 13.37 | 49.67 | 102.67 | 55.67 | 19.88 | 57.67 | 100.33 | 26.17 | 16.75 | 52.00 | 110.00 | 45.00 |
| 2,4-D | $10^2$ | 21.25 | 54.00 | 112.35 | 16.70 | 14.84 | 48.33 | 105.00 | 53.33 | 20.63 | 56.00 | 115.67 | 36.50 | 17.53 | 48.00 | 117.33 | 52.90 |
| 2,4-D | $10^3$ | 21.00 | 52.00 | 108.64 | 13.16 | 15.00 | 46.67 | 113.33 | 50.67 | 21.16 | 53.67 | 120.00 | 34.33 | 17.88 | 46.00 | 123.67 | 53.00 |
| CD at 5% | | 0.41 | 1.88 | 7.58 | 4.25 | 0.29 | 3.08 | 4.76 | 5.31 | 0.44 | 2.77 | 4.88 | 4.54 | 0.40 | 3.27 | 5.66 | 4.35 |

**Table-2a:** Effect of growth regulators priming on seed yield per plant, harvest index and some other traits in mungbean in years (2012).

| Growth Regulators | Doses | Days of pods maturity | Seed yield / plant | Plant biomass | Harvest index | Days of pods maturity | Seed yield/ plant | Plant biomass | Harvest index | Days of pods maturity | Seed yield / plant | Plant biomass | Harvest index | Days of pods maturity | Seed yield/ plant | Plant biomass | Harvest index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pant mung-5 | | | | SML-668 | | | | P-9072 | | | | K-851 | | | |
| Control | | 60.00 | 12.46 | 50.08 | 24.88 | 73.50 | 11.43 | 56.08 | 20.38 | 69.00 | 12.10 | 59.25 | 20.42 | 70.67 | 8.52 | 54.67 | 15.58 |
| GA | $10^1$ | 67.17 | 16.05 | 53.33 | 30.09 | 73.33 | 13.88 | 59.67 | 23.26 | 61.33 | 18.55 | 56.58 | 32.29 | 69.27 | 14.56 | 68.92 | 21.13 |
| GA | $10^2$ | 75.33 | 14.88 | 49.58 | 30.01 | 75.77 | 13.22 | 59.33 | 22.28 | 64.67 | 15.20 | 52.58 | 28.91 | 70.23 | 12.50 | 65.17 | 19.18 |
| GA | $10^3$ | 77.00 | 13.52 | 45.17 | 29.93 | 77.30 | 10.73 | 56.42 | 19.02 | 66.67 | 12.10 | 47.33 | 25.57 | 72.67 | 10.01 | 60.58 | 16.52 |
| BA | $10^1$ | 63.33 | 13.00 | 45.50 | 28.57 | 64.00 | 10.29 | 54.92 | 18.74 | 68.00 | 14.05 | 52.25 | 26.89 | 71.27 | 8.19 | 57.08 | 14.35 |
| BA | $10^2$ | 67.17 | 12.34 | 44.17 | 27.94 | 72.33 | 9.14 | 53.42 | 17.11 | 71.00 | 10.12 | 50.00 | 20.24 | 73.33 | 7.12 | 54.42 | 1308 |
| BA | $10^3$ | 69.27 | 12.00 | 43.50 | 27.59 | 73.33 | 7.58 | 49.83 | 15.21 | 74.33 | 7.25 | 38.33 | 18.91 | 75.13 | 6.54 | 53.58 | 12.21 |
| IAA | $10^1$ | 65.67 | 18.69 | 55.92 | 33.42 | 72.67 | 13.60 | 58.73 | 23.16 | 68.00 | 17.72 | 51.25 | 34.24 | 70.87 | 12.50 | 66.58 | 18.77 |
| IAA | $10^2$ | 72.17 | 16.87 | 53.75 | 31.39 | 74.87 | 12.18 | 57.50 | 21.13 | 70.00 | 13.75 | 46.17 | 29.78 | 73.27 | 8.56 | 55.83 | 15.33 |
| IAA | $10^3$ | 77.67 | 13.42 | 46.25 | 29.02 | 76.67 | 9.90 | 51.42 | 19.25 | 72.00 | 10.53 | 42.00 | 12.12 | 75.13 | 7.57 | 54.25 | 13.95 |
| TIBA | $10^1$ | 59.00 | 14.90 | 43.58 | 34.19 | 64.17 | 11.57 | 47.75 | 24.23 | 61.33 | 13.90 | 46.50 | 29.89 | 67.33 | 12.52 | 56.92 | 22.00 |
| TIBA | $10^2$ | 57.33 | 17.12 | 46.92 | 36.49 | 63.33 | 13.00 | 49.75 | 26.13 | 59.17 | 15.75 | 48.17 | 32.70 | 65.27 | 15.20 | 61.50 | 24.72 |
| TIBA | $10^3$ | 54.67 | 20.50 | 48.25 | 42.49 | 62.17 | 16.00 | 52.25 | 30.62 | 50.43 | 19.05 | 52.08 | 36.58 | 64.13 | 16.98 | 63.50 | 26.74 |
| 2,4-D | $10^1$ | 59.00 | 15.00 | 41.42 | 36.21 | 64.67 | 12.70 | 47.92 | 26.50 | 61.00 | 13.85 | 44.82 | 30.83 | 62.27 | 13.62 | 57.83 | 23.55 |
| 2,4-D | $10^2$ | 60.00 | 18.00 | 44.92 | 40.07 | 63.73 | 14.00 | 48.83 | 28.69 | 54.17 | 17.92 | 51.67 | 34.68 | 61.33 | 16.08 | 61.17 | 26.29 |
| 2,4-D | $10^3$ | 56.33 | 22.25 | 48.92 | 45.48 | 61.67 | 16.13 | 52.08 | 30.92 | 57.67 | 21.12 | 53.67 | 39.25 | 60.13 | 19.11 | 66.58 | 28.70 |
| CD at 5% | | 6.58 | 1.564 | 1.151 | 0.52 | 6.15 | 1.651 | 0.872 | 0.59 | 7.08 | 1.355 | 0.873 | 0.35 | 4.50 | 1.334 | 1.080 | .042 |

**Table-2a:** Effect of growth regulators priming on seed yield per plant, harvest index and some other traits in mungbean in years (2012).

| Growth Regulators | Doses | Days of pods maturity | Seed yield / plant | Plant biomass | Harvest index | Days of pods maturity | Seed yield/ plant | Plant biomass | Harvest index | Days of pods maturity | Seed yield / plant | Plant bio-mass | Harvest index | Days of pods maturity | Seed yield/ plant | Plant bio-mass | Harvest index |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pant mung-5 | | | | SML-668 | | | | P-9072 | | | | K-851 | | | |
| Control | | 63.00 | 15.39 | 52.67 | 29.22 | 75.50 | 12.44 | 58.67 | 21.20 | 67.33 | 12.45 | 57.67 | 21.59 | 72.67 | 11.50 | 67.25 | 17.10 |
| GA | $10^1$ | 69.17 | 20.00 | 55.92 | 35.77 | 75.33 | 14.34 | 72.25 | 19.85 | 63.33 | 16.00 | 54.17 | 29.54 | 71.27 | 15.64 | 76.50 | 20.44 |
| GA | $10^2$ | 78.33 | 15.10 | 44.67 | 33.80 | 78.77 | 12.06 | 69.42 | 17.37 | 66.67 | 14.62 | 50.17 | 29.14 | 72.23 | 13.23 | 72.75 | 18.19 |
| GA | $10^3$ | 80.00 | 12.12 | 37.75 | 32.11 | 80.30 | 12.77 | 61.50 | 20.76 | 68.67 | 13.13 | 49.92 | 23.28 | 74.67 | 10.27 | 65.67 | 15.64 |
| BA | $10^1$ | 64.33 | 12.90 | 45.58 | 28.30 | 65.00 | 11.73 | 57.50 | 20.40 | 70.00 | 15.80 | 59.83 | 26.41 | 73.27 | 07.38 | 64.67 | 11.41 |
| BA | $10^2$ | 70.17 | 11.40 | 41.75 | 27.31 | 74.33 | 09.04 | 53.50 | 16.90 | 73.00 | 10.87 | 47.58 | 22.85 | 76.33 | 07.02 | 62.00 | 11.32 |
| BA | $10^3$ | 73.27 | 10.60 | 38.58 | 25.92 | 75.33 | 08.96 | 44.92 | 19.95 | 77.33 | 08.70 | 43.42 | 20.04 | 78.13 | 06.42 | 58.67 | 11.62 |
| IAA | $10^1$ | 67.67 | 17.20 | 51.00 | 33.73 | 74.67 | 14.02 | 46.25 | 21.16 | 70.00 | 17.50 | 59.33 | 29.50 | 72.87 | 13.02 | 59.17 | 18.82 |
| IAA | $10^2$ | 76.16 | 14.90 | 48.33 | 30.51 | 76.87 | 11.25 | 62.58 | 17.98 | 72.00 | 15.00 | 53.75 | 27.91 | 75.27 | 11.02 | 65.92 | 16.72 |
| IAA | $10^3$ | 80.67 | 10.25 | 33.83 | 30.30 | 79.67 | 12.92 | 46.50 | 27.78 | 75.00 | 11.97 | 47.08 | 25.42 | 78.13 | 08.58 | 61.83 | 13.88 |
| TIBA | $10^1$ | 60.00 | 13.65 | 41.17 | 33.16 | 66.20 | 12.67 | 37.83 | 33.52 | 63.33 | 13.40 | 46.58 | 28.77 | 69.33 | 09.55 | 49.50 | 19.29 |
| TIBA | $10^2$ | 76.16 | 17.50 | 47.00 | 37.23 | 64.33 | 13.08 | 44.83 | 29.18 | 61.17 | 19.95 | 55.75 | 35.78 | 67.27 | 13.86 | 50.92 | 24.22 |
| TIBA | $10^3$ | 56.67 | 21.25 | 48.33 | 43.97 | 63.17 | 14.43 | 52.33 | 27.58 | 57.43 | 22.50 | 59.67 | 37.71 | 66.13 | 14.28 | 53.58 | 26.65 |
| 2,4-D | $10^1$ | 61.00 | 12.12 | 34.00 | 35.65 | 68.33 | 15.53 | 38.00 | 40.87 | 62.00 | 12.70 | 45.00 | 28.22 | 64.27 | 10.08 | 42.92 | 21.04 |
| 2,4-D | $10^2$ | 63.00 | 15.05 | 37.50 | 40.13 | 64.73 | 16.33 | 41.42 | 39.43 | 60.17 | 16.15 | 49.25 | 32.79 | 63.33 | 13.72 | 56.25 | 24.39 |
| 2,4-D | $10^3$ | 54.33 | 19.50 | 44.00 | 44.32 | 62.67 | 16.38 | 49.67 | 28.95 | 58.67 | 22.00 | 56.25 | 39.11 | 61.13 | 12.53 | 54.17 | 32.36 |
| CD at 5% | | 0.47 | 1.460 | 2.919 | 0.50 | 6.64 | 1.949 | 2.852 | 0.37 | 7.06 | 1.733 | 2.754 | 0.45 | 9.55 | 1.372 | 2.556 | 0.35 |

behaved like control as the number of flowers dropped was similar to control. In case of varieties Pant mung-5 and P-9072, TIBA and 2,4-D at all doses induced less number of flowers dropped as compared to control. On the other hand, GA and IAA at all doses had significantly more number of flowers dropped/plant compared to control except $10^{-2}$ dose of IAA in variety P-9072. In case of 2,4-D at $10^{-3}$ dose in 2012, the number of flowers dropped/plant were least. It is a general observation that in Pant mung-5, the numbers of flowers dropped/plant in 2013 were more than in 2012. These results are in conformity with the findings of (6).

**Days of pods maturity :** It was observed in table 2a and 2b that in varieties SML-668 and K-851 in both years there was significant impact of the individual growth regulators whereas their doses and the interaction also showed a significant impact. The 10-3 dose of GA, IAA and BA delayed the pod maturity in both K-851 and SML-668 in both the years whereas the same dose of TIBA and 2, 4-D reduced the number of days to pod maturity. Within TIBA and 2, 4-D, $10^{-1}$ dose delayed the pod maturity by 4-5 days as compared to the $10^{-3}$ dose but in case of GA, IAA and BA the impact of the dose was reversed the $10^{-1}$ dose reduced whereas $10^{-3}$ increased the number of days to pod maturity. Maximum days (80.30) were taken by $10^{-3}$ dose of GA whereas minimum number of days (60.13) were taken by $10^{-3}$ dose of 2,4-D. These results confirm the findings of (1). In the varieties Pant mung-5 and P-9072, the significant differences between the growth regulators when compared with each other and also when compared to control. Even the impacts of the doses of each growth regulator were found significant. The impact of BA was very important as all doses delayed the pod maturity like to the same doses of GA and IAA. The general behaviour of the doses of BA was similar to GA and IAA. On the other hand, the response was reversed when compared to TIBA and 2,4-D. This behaviour of BA indicates that the response of the varieties to BA is closer to GA and IAA but entirely different than 2,4-D and TIBA. In case of varieties Pant mung-5 and P-9072, the behaviour of all growth regulators was the same as in case of varieties K-851 and SML-668 but the number of days taken to pod maturity were more in general, in IAA the dose $10^{-3}$ took maximum number of days (80.67) whereas the minimum number of days (52.33) were taken by $10^{-3}$ dose of 2, 4-D. Similar results were reported by (2).

**Seed yield/plant :** The data given in table 2a and 2b revealed that In varieties Pant mung-5 and P-9072 there has been significant and substantial increasement in seed yield/plant in case of $10^{-3}$ dose of 2,4-D and TIBA as compared to the control. However, 2, 4-D is better than TIBA in increasing the yield at $10^{-3}$ dose. In both GA and IAA the $10^{-1}$ dose also induced significantly better yield but it was substantially less than the $10^{-3}$ dose of both TIBA and 2, 4-D. BA at all doses except at $10^{-3}$ dose in P-9072 in both years was close to the control but the response of Pant mung-5 was better than the P-9072. In varieties K-851 and SML-668 the response of the growth regulator was like that of Pant mung-5 and P 9072 but the quantum of seed yield was poor in the varieties K-851 and SML-668 as compared to the varieties Pant mung-5 and P-9072. These results are in conformity with the findings of (1) it can be concluded that TIBA and 2,4-D at lower dose of $10^{-3}$ induced better seed yield as compared to $10^{-1}$ dose of GA and IAA. Between varieties SML-668 and K-851, K-851was better responding then SML-668 and between varieties P 9072 and Pant mung-5, Pant mung-5 was better than P-9072 (2).

**Plant biomass :** The results concerning plant biomass of the varieties SML-668 and K-851 treated with GA was much higher as compared to control and the varieties Pant mung-5 and P-9072. The growth regulators induced higher vegetative growth in case of SML-668 and K-851 than pant mung-5 and P-9072 in 2012. In the varieties Pant mung-5 and P-9072, the dose $10^{-1}$ of GA, IAA and BA induced higher plant biomass in both the years as compared to $10^{-2}$ and $10^{-3}$ doses whereas this trend was reversed in case of TIBA and 2,4-D where in $10^{-1}$ induced lower biomass as compared to both $10^{-2}$ and $10^{-3}$. 2,4-D and TIBA induced much less plant biomass whereas at $10^{-1}$ GA and IAA were almost at per with control. When various doses of TIBA and 2, 4-D are compared within themselves, 2, 4-D induced the lowest biomass in 2013 at $10^{-1}$ dose and higher biomass was induced by TIBA at $10^{-3}$ in 2013. In varieties K-851 and SML-668, the growth regulators GA, IAA and BA at $10^{-1}$ dose increased the plant biomass in order GA>IAA>BA. Between the growth regulators, GA at all the doses increased the plant biomass over control, therefore, acting as a true growth promoter for the vegetative parts. BA at all doses except $10^{-1}$ in 2012 significantly reduced the plant biomass as compared to control. GA, IAA and BA in general induced higher plant biomass at higher doses and lower biomass at lower doses. In case of TIBA and 2, 4-D, in general, the plant biomass was much lower than the GA and IAA. However, the plant biomasses of the BA treatments were in general lower than either those of GA and IAA. The lowest plant biomass was induced by 2, 4-D at $10^{-1}$ in the variety Pant mung-5 in 2013. These results are in full agreement with those observations by (7).

**Harvest index :** The data given in table 2a and 2b revealed that In case of varieties K-851 and SML-668, all the doses of TIBA and 2,4-D induced substantially and significantly higher harvest index as compared to all the doses of GA, IAA and BA in decreasing order the BA was least effective. Specifically the dose of $10^{-3}$ of 2,4-D was more effective than the corresponding dose of TIBA. As compared to the control, all the doses of TIBA and 2,4-D are significantly superior whereas BA at all doses was significantly inferior in inducing the harvest index. Both GA and IAA were almost equal to control. In varieties Pant mung-5 and P-9072, the lowest dose $10^{-3}$ of both TIBA and 2, 4-D were superior to other doses. This dose was significantly and substantially superior as compared to control. BA at all doses was almost at par with control. The results show that for increasing the harvest index, 2,4-D at $10^{-3}$ is the best dose as the case is with TIBA. 2,4-D at $10^{-2}$ was also quite superior to the other doses. The varieties P-9072 and Pant mung-5 responded better than the varieties K-851and SML-668 whereas Pant mung-5 performed better than the SML-668 These results are in conformity with the findings of (1, 2) it therefore appears that 2,4-D and TIBA will ultimately result into better seed yield as they induced better harvest index and the plant biomass.

## CONCLUSION

The findings of present study clearly indicate the role of proper varieties and growth regulators for getting higher seed yield/plant in variety pant mung-5 followed by K-851, P-9072 and SML-668 gave better results in that order use of 2,4-D dose $10^{-3}$ give higher seed yield/ plant was best than all other growth regulators for achieving better number of leaves/plant, number of days of flower initiation, number of flowers/plant, number of flowers dropped, days of pods maturity, plant biomass and harvest index, under Agra region.

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