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### Impact of different Pigeonpea based intercrop vegetables on growth, and yield of Pigeonpea

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#### Abstract

A field experiment conducted at post graduate institute research farm, Mahatma Phule Krishi Vidyapeeth, Rahuri Dist-Ahmednagar (MH), on medium to black soil to study the performance of different leafy vegetable in Pigeonpea based intercropping system during 2019-20 and 2020-21. The experiment laid out in randomized block design consist of seven sole treatments viz., T<sub>1</sub> - Sole Pigeonpea, T<sub>2</sub> - Sole coriander, T<sub>3</sub> - Sole Spinach, T<sub>4</sub> - Sole Sorrel, T<sub>5</sub> Sole Safflower, T<sub>6</sub> - Sole Dill, T<sub>7</sub> - Sole Fenugreek and six Pigeonpea based intercropping systems viz., T<sub>8</sub> - Pigeonpea + coriander (1:3), T<sub>9</sub> - Pigeonpea + Spinach (1:3), T<sub>10</sub> - Pigeonpea + Sorrel (1:3), T<sub>11</sub> - Pigeonpea + Safflower (1:3), T<sub>12</sub> - Pigeonpea + Dill (1:3) and T<sub>13</sub> - Pigeonpea + Fenugreek (1:3). the result revealed that the treatment T<sub>1</sub>- sole Pigeonpea recorded significantly highest plant height (187.25 and 188.29), more number of leaves (155.61 and 167.39), highest leaf area (2190.51 and 2285.67) and also high amount of dry matter accumulation (458.74 and 477.49) followed by treatment T<sub>13</sub> (Pigeonpea + Fenugreek, 1:3)

**Keywords:** Pigeonpea (*Cajanus cajan*), intercropping, leafy vegetables, fenugreek, coriander, spinach, sorrel, safflower, dill, growth attributes, yield, pigeonpea-based cropping system, dry matter accumulation, leaf area, randomized block design.

#### Introduction

India is the largest producer and consumer of pulses in the world accounting for 35 percent area and 27 percent production in the world (Chaturvedi and Ali, 2002). The total area under pulses is 23.63 million hectares with an annual production of 14.56 million tonnes and productivity of 625 kg ha<sup>-1</sup> in the country (Ali, 2009). Pigeon-pea is one of the important grain legumes, grown predominantly in the semi-arid tropics of the Indian sub-continent, which contributes nearly 92 percent of the total world production of Pigeonpea. Traditionally, over 90 percent of crop comprising of medium and long duration varieties was cultivated as mixed or intercrop with cereals, short duration legumes etc. The low yield of Pigeonpea is not only due to its cultivation on sub-marginal lands, but also because of inadequate and imbalance fertilizers, which decreased the productivity, sustainability, soil health and finally affected environment World population is increasing at an alarming rate. Intercropping system has many advantages, such as increase in yield, which include greater stability of production, minimum risk, more equal distribution of labour during crop growing season with greater diversity of food and income sources. This soil crop management practices provides biological insurance, improvement in soil properties, and better control of weeds, pests and diseases.

#### Material and Methods

The field experiment was conducted on post graduate institute research farm, Mahatma Phule Krishi Vidyapeeth,

Rahuri Dist-Ahmednagar (MH), on medium to black soil Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, District Ahmednagar, (M.S.) during kharif season of year 2019-20 and 2020-21 for two consecutive years. The experimental soil was clay loam with pH 8.47 and 8.51, EC- 0.38 and 0.17 dS/m, available nitrogen 295 and 163 kg/ha, available phosphorus 13.64 and 5.0 kg/ha, and available potash 357 and 190 kg/ha during 2006- 07 and 2007-08, respectively. The experiment consisted of 13 treatment combinations grown in three replications in a randomized block design.

The experiment was laid out in a randomized complete block design (RBD comprised of thirteen treatments which were replicated thrice. From treatment number one to seven (T<sub>1</sub> - T<sub>7</sub>), base crop (Pigeonpea) and all intercrops. The seeds of Pigeonpea variety Phule BDN-711 was dibbled at 90 X 20 cm spacing, while intercrops were sown/planted as per row proportion decided by recommended spacing. Seven treatment consists of sole cropping system viz., T<sub>1</sub> - Sole Pigeonpea, T<sub>2</sub> - Sole coriander, T<sub>3</sub> - Sole Spinach, T<sub>4</sub> - Sole Sorrel, T<sub>5</sub> Sole Safflower, T<sub>6</sub> - Sole Dill, T<sub>7</sub> - Sole Fenugreek and six Pigeonpea based intercropping systems viz., T<sub>8</sub> - Pigeonpea + coriander (1:3), T<sub>9</sub> - Pigeonpea + Spinach (1:3), T<sub>10</sub> - Pigeonpea + Sorrel (1:3), T<sub>11</sub> - Pigeonpea + Safflower (1:3), T<sub>12</sub> - Pigeonpea + Dill (1:3) and T<sub>13</sub> - Pigeonpea + Fenugreek (1:3) in kharif. All these spacing were recommended for sole as well as intercropping

of pulse crops with Pigeonpea. A rainfall of 575.6 mm and 530.2 mm was received during the respective cropping seasons. The grain yield was calculated per hectare on the basis of net plot yields. From the basic data the values of gross and net monetary returns, land equivalent ratios were calculated.

## Results and Discussion

### Growth parameters of Pigeonpea

The growth attributing parameters of Pigeonpea (plant height, number of primary and secondary branches plant<sup>-1</sup>, dry matter accumulation plant<sup>-1</sup> and number of root nodules plant<sup>-1</sup>) influenced by intercropping of different crops recorded at 90 DAS and at harvest during experimental year 2019-20 and 2020-21.

#### 1 Plant height

The data on periodic plant height of Pigeonpea as influenced by intercropping of different crops was recorded at 90 days after sowing (DAS). The data showed that there was a progressive increase in plant height with the advancement of crop age during both the years experimentation. At 90 DAS, maximum plant height was recorded in T<sub>1</sub>-sole Pigeonpea (142.44 and 143.67 cm) which was found statistically at par with the plant height recorded under T<sub>13</sub>- Pigeonpea + Fenugreek 1:3 at ratio (141.50 and 142.56) and T<sub>12</sub>- Pigeonpea + Dill at 1:3 ratio (140.65 and 141.44) intercropping systems during both the years but significantly higher from T<sub>9</sub>- Pigeonpea + Spinach at 1:3 ratio (135.21 and 136.54). The same trend of plant height was found at harvest stage during both years of research. Srichandan and Mangaraj (2015) [9] and Paul *et al.*, (2016) [3] made similar observations in Pigeonpea + Maize/Pearlmillet/Sorghum intercropping and attributed to negative effects of the intercropped cereal crop on the Pigeonpea component.

#### Number of leaves plant<sup>-1</sup>

Under each intercropping system, the Pigeonpea plants had reduced number of branches plant<sup>-1</sup> compared to T<sub>1</sub> (sole Pigeonpea). More number of leaves in sole Pigeonpea were observed and it might be due to no any competition for

growth limiting factors and more space was available for increasing leaves of Pigeonpea.

Number of leaves plant<sup>-1</sup> Pigeonpea at 90 DAS and Harvest are influenced by different intercropping treatments viz, T<sub>1</sub> has highest number of leaves plant<sup>-1</sup> (245.93 and 253.39) and it was at par with T<sub>13</sub>- Pigeonpea + Fenugreek 1:3 at ratio (235.56 and 248.80) intercropping systems during both the years but significantly higher from T<sub>9</sub>- Pigeonpea + Spinach at 1:3 ratio (221.77 and 230.74). It was due to the Optimal Growing Conditions, Water Availability and efficient plant density conditions available for Pigeonpea.

#### Dry matter accumulation (DMA) plant<sup>-1</sup> (g).

The dry matter accumulation plant<sup>-1</sup> was also influenced by different treatments Pigeonpea based intercrops (vegetables). Two years data of experiment revealed that highest number of dry matter accumulation plant<sup>-1</sup> in Pigeonpea was observed in T<sub>1</sub>- Sole Pigeonpea (234.71 and 263.74) intercropping systems during both the years and at par with T<sub>13</sub>- Pigeonpea + Fenugreek 1:3 at ratio (229.06 and 257.88 but significantly higher from T<sub>9</sub>- Pigeonpea + Spinach at 1:3 ratio (234.71 and 230.74). Fenugreek, being a legume, can also fix nitrogen, which can benefit the Pigeonpea plant. The nitrogen fixed by fenugreek can be absorbed by the Pigeonpea, enhancing its vegetative growth, resulting in more leaves. Pigeonpea's leaves may also contribute organic matter to the soil, which can further benefit fenugreek growth.

#### Leaf area of Pigeonpea as influenced by different treatment

The various treatments of Pigeonpea-based intercrops (vegetables) also had an impact on the Leaf area plant<sup>-1</sup>. The experiment's two-year data showed that the T<sub>1</sub>-Sole Pigeonpea intercropping systems had the highest Leaf area accumulation plants<sup>-1</sup> in Pigeonpea (2717.54 and 2827.74 dm<sup>2</sup>) during both years. These systems were comparable to T<sub>13</sub>-Pigeonpea + Fenugreek 1:3 at ratio (2596.60 and 2774.22), but they were significantly higher than T<sub>9</sub>- Pigeonpea + Spinach at 1:3 ratio (2145.74 and 2241.27).

**Table 1:** Impact on growth attributing character

| Treatments                             | Plant height (cm) 90 DAS |         | Number of leaves plant <sup>-1</sup> 90 DAS |         | DMA plant <sup>-1</sup> (g). 90 DAS |         | Leaf area plant <sup>-1</sup> 90 DAS |         |
|----------------------------------------|--------------------------|---------|---------------------------------------------|---------|-------------------------------------|---------|--------------------------------------|---------|
|                                        | 2019-20                  | 2020-21 | 2019-20                                     | 2020-21 | 2019-20                             | 2020-21 | 2019-20                              | 2020-21 |
| T <sub>1</sub> - Sole Pigeonpea        | 142.44                   | 143.67  | 245.93                                      | 253.39  | 234.71                              | 263.74  | 2717.54                              | 2827.74 |
| T <sub>2</sub> - Sole Coriander        | -                        | -       | -                                           | -       | -                                   | -       | -                                    | -       |
| T <sub>3</sub> - Sole Spinach          | -                        | -       | -                                           | -       | -                                   | -       | -                                    | -       |
| T <sub>4</sub> - Sole Sorrel           | -                        | -       | -                                           | -       | -                                   | -       | -                                    | -       |
| T <sub>5</sub> - Sole Safflower        | -                        | -       | -                                           | -       | -                                   | -       | -                                    | -       |
| T <sub>6</sub> - Sole Dill             | -                        | -       | -                                           | -       | -                                   | -       | -                                    | -       |
| T <sub>7</sub> - Sole fenugreek        | -                        | -       | -                                           | -       | -                                   | -       | -                                    | -       |
| T <sub>8</sub> - PP + Coriander (1:3)  | 139.18                   | 140.10  | 230.36                                      | 239.32  | 225.12                              | 251.88  | 2445.02                              | 2540.55 |
| T <sub>9</sub> - PP + Spinach (1:3)    | 135.21                   | 136.54  | 221.77                                      | 230.74  | 221.24                              | 248.23  | 2145.74                              | 2241.27 |
| T <sub>10</sub> - PP + Sorrel (1:3)    | 136.57                   | 137.67  | 223.76                                      | 232.81  | 222.18                              | 248.94  | 2260.94                              | 2356.47 |
| T <sub>11</sub> - PP + Safflower (1:3) | 137.64                   | 138.73  | 227.30                                      | 235.92  | 224.49                              | 251.27  | 2277.72                              | 2373.25 |
| T <sub>12</sub> - PP + Dill (1:3)      | 140.65                   | 141.44  | 233.14                                      | 242.22  | 227.95                              | 254.71  | 2567.10                              | 2618.97 |
| T <sub>13</sub> - PP+ Fenugreek (1:3)  | 141.50                   | 142.56  | 238.56                                      | 248.80  | 229.06                              | 257.88  | 2596.60                              | 2774.22 |
| SE                                     | 0.57                     | 0.42    | 2.77                                        | 1.54    | 1.99                                | 2.35    | 25.94                                | 74.94   |
| CD @ 5%                                | 1.77                     | 1.29    | 8.55                                        | 4.75    | 6.12                                | 7.25    | 79.93                                | 230.92  |
| GM                                     | 139.03                   | 140.10  | 231.55                                      | 240.46  | 226.39                              | 253.81  | 2430.09                              | 2533.21 |

**Table 2:** Impact on yield attributing character

| Treatments                             | Yield attributing character of pigeonpea |                               |                                    |                                     |                     |                                 |                               |                                    |                                     |                     |
|----------------------------------------|------------------------------------------|-------------------------------|------------------------------------|-------------------------------------|---------------------|---------------------------------|-------------------------------|------------------------------------|-------------------------------------|---------------------|
|                                        | 2019-20                                  |                               |                                    |                                     |                     | 2020-21                         |                               |                                    |                                     |                     |
|                                        | No. of pods plant <sup>-1</sup>          | No. of seed pod <sup>-1</sup> | Pod weight plant <sup>-1</sup> (g) | Seed weight plant <sup>-1</sup> (g) | 100 seed weight (g) | No. of pods plant <sup>-1</sup> | No. of seed pod <sup>-1</sup> | Pod weight plant <sup>-1</sup> (g) | Seed weight plant <sup>-1</sup> (g) | 100 seed weight (g) |
| T <sub>1</sub> - Sole Pigeonpea        | 211.89                                   | 2.78                          | 158.80                             | 105.71                              | 9.81                | 228.30                          | 2.86                          | 170.85                             | 115.65                              | 10.03               |
| T <sub>2</sub> - Sole Coriander        | -                                        | -                             | -                                  | -                                   | -                   | -                               | -                             | -                                  | -                                   | -                   |
| T <sub>3</sub> - Sole Spinach          | -                                        | -                             | -                                  | -                                   | -                   | -                               | -                             | -                                  | -                                   | -                   |
| T <sub>4</sub> - Sole Sorrel           | -                                        | -                             | -                                  | -                                   | -                   | -                               | -                             | -                                  | -                                   | -                   |
| T <sub>5</sub> - Sole Safflower        | -                                        | -                             | -                                  | -                                   | -                   | -                               | -                             | -                                  | -                                   | -                   |
| T <sub>6</sub> - Sole Dill             | -                                        | -                             | -                                  | -                                   | -                   | -                               | -                             | -                                  | -                                   | -                   |
| T <sub>7</sub> - Sole fenugreek        | -                                        | -                             | -                                  | -                                   | -                   | -                               | -                             | -                                  | -                                   | -                   |
| T <sub>8</sub> - PP + Coriander (1:3)  | 175.61                                   | 2.71                          | 134.42                             | 90.46                               | 9.76                | 193.32                          | 2.82                          | 147.91                             | 101.41                              | 9.93                |
| T <sub>9</sub> - PP + Spinach (1:3)    | 155.57                                   | 2.66                          | 117.56                             | 75.38                               | 9.72                | 171.99                          | 2.76                          | 131.05                             | 86.33                               | 9.88                |
| T <sub>10</sub> - PP + Sorrel (1:3)    | 161.01                                   | 2.68                          | 125.29                             | 76.72                               | 9.73                | 175.76                          | 2.79                          | 138.77                             | 87.67                               | 9.90                |
| T <sub>11</sub> - PP + Safflower (1:3) | 166.62                                   | 2.70                          | 129.59                             | 85.47                               | 9.75                | 183.03                          | 2.81                          | 143.13                             | 96.42                               | 9.92                |
| T <sub>12</sub> - PP + Dill (1:3)      | 190.98                                   | 2.73                          | 142.76                             | 93.38                               | 9.78                | 207.39                          | 2.84                          | 156.25                             | 104.33                              | 9.95                |
| T <sub>13</sub> - PP+ Fenugreek (1:3)  | 205.12                                   | 2.75                          | 150.46                             | 99.48                               | 9.79                | 221.53                          | 2.85                          | 161.68                             | 110.43                              | 9.98                |
| SE±                                    | 2.55                                     | 0.03                          | 3.12                               | 3.03                                | 0.22                | 2.77                            | 0.02                          | 3.53                               | 2.50                                | 0.23                |
| CD @ 5%                                | 7.85                                     | NS                            | 9.61                               | 9.33                                | NS                  | 8.53                            | NS                            | 10.89                              | 7.72                                | NS                  |
| GM                                     | 180.97                                   | 2.72                          | 136.98                             | 89.51                               | 9.76                | 197.33                          | 2.82                          | 149.95                             | 100.32                              | 9.94                |

**Impact on Yield Attributing character****Number of pods plant<sup>-1</sup>**

The number of pod plant<sup>-1</sup> were influenced significantly due to intercropping of different crops in either of the two years and on pooled mean basis also. However, the T<sub>1</sub> (sole Pigeonpea) had recorded numerically maximum number of pod plant<sup>-1</sup> (211.89 & 228.30 during both years and pooled mean, respectively) and which was followed by during both the years and on pooled mean basis. Further, numerically minimum number of seeds pod<sup>-1</sup> were recorded in T<sub>9</sub> [Pigeonpea + spinach (1:3)], T<sub>13</sub> [Pigeonpea + sorrel (1:3)] during both the years of experiment and pooled mean also. These results are in conformity with the findings of Saxena and Yada (1979) and Sekhon *et al.*, (2017) who reported that intercropping of different crops did not influence significantly the number of seeds pod<sup>-1</sup> of Pigeonpea.

**Number of seed pod<sup>-1</sup>**

The number of pod plant<sup>-1</sup> were influenced significantly due to intercropping of different crops in either of the two years and on pooled mean basis also. However, the T<sub>1</sub> (sole Pigeonpea) had recorded numerically maximum number of seeds pod<sup>-1</sup> (2.78 and 2.86 during both years and pooled mean, respectively).

**Pod weight plant<sup>-1</sup> (g)**

The data on mean weight of pods plant<sup>-1</sup> of Pigeonpea are presented in Table. The mean values related to weight of pods plant<sup>-1</sup> was 136.98 and 149.95, g during first year, second year and on pooled mean basis, respectively. Revealed that weight of pods plant<sup>-1</sup> of Pigeonpea was

differed significantly due to intercropping of different crops during both the years and also on pooled mean basis. The results data showed that among the different cropping systems,

The treatment T<sub>1</sub> (sole Pigeonpea) recorded highest weight of pods plant<sup>-1</sup> g during two years and pooled mean analysis, respectively) and which was significantly superior over the all treatments.

In which intercropping of different crops were taken with Pigeonpea. However, treatment T<sub>1</sub> (sole Pigeonpea) was numerically comparable with T<sub>11</sub> [Pigeonpea + fenugreek (1:3)] and T<sub>10</sub> [Pigeonpea + spinach (1:3)] and were recorded and 121.51, 126.01 & 123.76 g pods per plant in T<sub>11</sub> and T<sub>10</sub> during year 2019, 2020 and pooled mean basis, respectively.

**Seed weight plant<sup>-1</sup> (g)**

The seed yield per plant is an important attribute and directly interrelated with the economic yield of plant. Seed yield per plant represents the culmination of a plant's physiological and metabolic processes, resulting from the combined effects of all factors that enhance growth, the number of pods per plant and the seed index. The observation for this parameter was recorded at harvest. The mean data regarding seed yield per plant is presented in Table. The mean values recorded in year 2019, 2020 and on pooled mean basis were 83.72, 86.94 and 85.33 g respectively. Data presented in table indicated significant differences in weight of seeds plant<sup>-1</sup> due to intercropping of various crops with Pigeonpea. In Pigeonpea, the data showed that treatment T<sub>1</sub> (sole Pigeonpea) recorded

significantly higher weight of seed plant<sup>-1</sup> (96.05, 101.8\75 and 89.41 during both years and on pooled analysis, respectively) over all intercropping treatments. The treatment T<sub>1</sub> (sole Pigeonpea) was followed by T<sub>11</sub> [Pigeonpea + spinach (1:3)] and T<sub>10</sub> [Pigeonpea + fenugreek (1:3)].

### 100 seed weight (g)

Data pertaining to 100 seed weight of Pigeonpea are presented in the table. It was found that 100 seed weight of Pigeonpea was not influenced significantly by intercropping of different crops with Pigeonpea. The average mean of data related to 100 seed weight recorded during year 2019-20, 2020-21 and pooled mean basis was 12.77, 13.24 and 12.50 g, respectively. The data presented in table revealed that, numerically higher values of 100 seed weight in Pigeonpea were recorded under treatment T<sub>11</sub> (sole Pigeonpea) and it was followed by during both the years of experiment and on pooled mean basis. Similarly, numerically lowest value of 100 grain weight was observed with treatment T<sub>9</sub> [Pigeonpea + spinach (1:3)] and which was followed by T<sub>13</sub> [Pigeonpea + sorrel (1:5)] and T<sub>12</sub> [Pigeonpea + fenugreek (1:3)]. These results are in conformity with the findings of Saxena and Yadav (1979) and Sekhon *et al.*, (2012).

### Conclusion

The study highlights that intercropping significantly affects the growth parameters and yield attributes of Pigeonpea, with sole Pigeonpea consistently outperforming intercropped systems in terms of plant height, leaf number, dry matter accumulation, and seed yield. The findings suggest that while intercropping can provide some benefits, it may also lead to competition that negatively impacts the growth and yield of Pigeonpea.

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