COMPARISON OF DIFFERENT COWPEA VARIETIES/LINES FOR GREEN FODDER AND GRAIN YIELD UNDER RAINFED CONDITIONS OF ISLAMABAD, PAKISTAN

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ABSTRACT

The study was conducted to compare five different cowpea varieties/lines for green fodder, dry matter, grain yield and yield parameters under rainfed conditions at National Agricultural Research Centre, Islamabad, Pakistan during August, 2007. Land was prepared by ploughing with moldboard plough, cultivator and finally plank. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications, keeping plot size of 1.8 x 6m. The parameters determined were tendril length (cm), number of branches plant⁻¹, number of leaves plant⁻¹, pods plant⁻¹, leaf area, green fodder yield, dry matter yield, pod length, seeds pod⁻¹, 1000 grain weight and green fodder yield at 5% pod formation. Results revealed that the cowpea cultivar CP/V-2 produced the highest green fodder yield (28.50 t ha⁻¹) and dry matter yield (6.53 t ha⁻¹) than all the other cowpea cultivars. It was concluded that the cowpea cultivar CP/V-2 produced the highest green fodder yield and can be recommended for the cultivation under the rainfed conditions of Pothowar region.

Key Words: Cowpea, varieties, yield, correlation, genotype, phenotype, environment


INTRODUCTION

The soils of Pakistan in general are deficient in fertility and especially N. The use of nitrogenous fertilizer in Pakistan is limited because of high cost, inadequate credit facilities and non-availability at proper time. Therefore, it is imperative that leguminous crops be included in the cropping systems as legumes are capable of enriching the nitrogen content of the soil by fixing atmospheric nitrogen (Hayat et al., 2008). It has been reported that net benefits of legumes are often equivalent to the addition of 50-100 kg of N/ha (Phoomthiasong et al., 2003). In Pakistan, availability of green fodder is the main limiting factor in livestock production and this shortage may rise up to 75% during feed scarcity period (Bashir et al., 2001). Legume fodder is important for livestock production because it is rich in protein, minerals, phosphorus, calcium and vitamins (Unkovich et al., 1997).

Cowpea (Vigna unguiculata) (Linn. Walp.) is a summer season crop belonging to family Caesalpiniaceae (Leguminosae). It is grown for grain, vegetable, and fodder purposes in moderately humid areas of tropics and sub tropics, although, some varieties show a considerable drought resistance (Muhammad et al., 1993). Being a leguminous crop, it adds nitrogen to the soil. It cannot withstand frost and excessive heat reduces its growth (Jackson, 2009). Besides being an excellent fodder legume crop, it improves nitrogen status of the soil. Cowpea fodder is also a rich source of crude protein (Sebetha et al., 2010). Cowpea is a multi purpose crop for the production of fodder, hay, grain or green manure while providing the rotational benefits of legumes (Bull and Mayfield, 1992).

Genotype x environment interaction remained always a serious problem in crop production while recommending a variety for some region/area in the developing countries, especially environment for commercial cultivation cannot be changed but genotype can be modified by hybridization and bio-tech methods to suit the available soil and climate related environmental conditions. For this purpose breeders are always collecting and creating genetic variability in crops for development of varieties suitable for diverse agro-climatic zones. One cultivar cannot be grown all over the country having multitude of environments. Crop outcome is a product of the genotype and the environment in which crop has been grown. Ideal variety is always one, which passes general adaptation with higher yield potential (Finlay and Wilkinson 1963).
No systematic research work appears to have been conducted on cowpea for its utility as a fodder crop in Pakistan. Therefore, the present study is designed to evaluate different varieties of cowpea for forage and dry matter yield and to promote cowpea cultivation in Pothowar region to fulfill the fodder requirements.

MATERIALS AND METHODS

The experiment was carried out to evaluate five different varieties/lines of cowpea for green fodder yield, grain yield and their components under rainfed conditions at National Agricultural Research Center, Islamabad during summer 2007. Soil type was non-calcareous silt clay with pH 7.4. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The plot size was 10.8 m². Sowing of the experiment was done on August 30, 2007. A seed rate of 40 kg ha⁻¹ was hand drilled by keeping 30 cm row-to-row spacing. One variety viz. P-518 and three lines viz. No.1, CP/V-2, CP/V-4, and CP/V-7 were tested in this study out of which P-518 line was control. Fertilizer dose of 25-60 NP kg ha⁻¹ and all the agronomic practices were kept uniform for all the varieties/lines. The crop was harvested at 5% pod formation from each plot for estimation of green fodder yield. Five plants were selected at random in each plot at the time of 5% pod formation Tendril length was measured with a meter rod, number of branches plant⁻¹ (B/P), number of leaves plant⁻¹ (L/P), pods plant⁻¹ (P/P) were counted, leaf area (LA) was measured with the help of a leaf area meter. Green fodder yield (GFY), dry matter yield (DMY), pod length (PL), seeds pod⁻¹ (S/P), 1000 grain weight (1000 GW) and grain yield (Grn Y) were also taken. One-kg green fodder sample at harvesting time was collected at random for estimating dry matter yield from each plot. The collected samples were weighed, dried in an oven at 100°C for 48h and up to a constant weight and again weighed to calculate the dry matter yield for each variety/line. The data collected were subjected to Fisher's analysis of variance technique and LSD Test at 5% probability level to compare the differences among treatments means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Yield and Yield Parameters

The data presented in (Table I) revealed that significant and highly significant differences were found among cowpea cultivars/lines in respect of yields and yield contributing characters.

Tendril Length

It was observed that cowpea line No.1 exhibited highest tendril length (63.11cm) followed by line CP/V4 (57.33 cm). The line CP/V2 (52.77 cm) had significantly the lowest in tendril length than all the other strains.

Number of branches plant⁻¹:

Cowpea line CP/V7 produced the highest number of branches plant⁻¹ (10.55) and statistically at par with check variety P-518 (10.22). Whereas, lowest number of branches per plant were recorded in the case of line No.1 (7.77).

Number of leaves plant⁻¹: Line CP/V7 produced the highest number of leaves plant⁻¹ (33.00) followed by lines CP/V2 (27.00), CP/V4 (26.22) and variety P-518 (26.00) which are at par with each other. Cowpea line No.1 produced the lowest (24.11) number of leaves plant⁻¹.

Number of pods plant⁻¹: Variety P-518 produced the highest number of pods plant⁻¹ (28.45) followed by lines CP/V2 (25.22) and CP/V7 (23.56). These two lines are at par with each other. Cowpea line No.1 produced the lowest number of pods plant⁻¹ (24.44).

Leaf area: Highly significant differences were also found in the leaf area which is the main contributor of the green fodder and dry matter yield. The data revealed that the highest leaf area was recorded in P-518 (77.11cm²) followed by CP/V7 (70.48 cm²) and No.1 (66.67 cm²). Among the tested cultivars/lines, CP/V2 attained last position by having leaf area (62.98 cm²) and it was statistically at par with CP/V4 (63.43 cm²). Highest leaf area in P-518 variety/line might be due to its genetic character and best adaptation to local conditions as compared to other varieties.

Yield: Differences were also found in green fodder yields among five different cowpea varieties/lines. According to results, the maximum green fodder yield (36.70 t ha⁻¹) was produced by the variety/line CP/V7 followed by lines P-518 (31.92 t ha⁻¹), No.1 (30.00 t ha⁻¹) and CP/V2 (28.50 t ha⁻¹). Whereas, the minimum green fodder yield was obtained by the variety/line CP/V4 (23.00 t ha⁻¹). Differences in dry matter yields of five different cowpea varieties/lines were observed. The maximum dry fodder yield (9.08 t ha⁻¹) was produced by the variety/line CP/V7 and followed by P-518 (8.70 t ha⁻¹) and No. 1 (7.76 t ha⁻¹). The minimum dry matter yield was recorded in the variety/line CP/V4 (5.61 t ha⁻¹) which was statistically at par with dry matter yield of line CP/V2 (6.53 t ha⁻¹).
**Table I**  Green fodder and grain yield and yield components of five different cowpea varieties / lines evaluated under rainfed conditions of Islamabad

<table>
<thead>
<tr>
<th>Varieties/ lines</th>
<th>Tendril length (cm)</th>
<th>Branch/ Plant</th>
<th>Leaves/ Plant</th>
<th>Pod/ Plant</th>
<th>Leaf Area (cm²)</th>
<th>GFY (t ha⁻¹)</th>
<th>Dry Matter Yield (t ha⁻¹)</th>
<th>PL (cm)</th>
<th>SP⁻¹</th>
<th>1000 Grain Wt. (g)</th>
<th>Grain Yield (t ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>63.1 A</td>
<td>7.8 D</td>
<td>24.1 C</td>
<td>12.4 D</td>
<td>66.7 C</td>
<td>30.0 AB</td>
<td>7.8 B</td>
<td>15.1 D</td>
<td>11.8 C</td>
<td>124.0 E</td>
<td>3.2 AB</td>
</tr>
<tr>
<td>CP/V2</td>
<td>52.8 C</td>
<td>8.3 C</td>
<td>27.0 B</td>
<td>25.2 B</td>
<td>63.0 D</td>
<td>28.5 AB</td>
<td>6.5 C</td>
<td>18.1 B</td>
<td>13.9 A</td>
<td>162.7 B</td>
<td>4.3 A</td>
</tr>
<tr>
<td>CP/V4</td>
<td>57.3 B</td>
<td>9.4 B</td>
<td>26.2 B</td>
<td>16.2 C</td>
<td>63.4 D</td>
<td>23.0 B</td>
<td>5.8 C</td>
<td>19.9 A</td>
<td>12.4 B</td>
<td>140.0 D</td>
<td>3.0 AB</td>
</tr>
<tr>
<td>CP/V7</td>
<td>56.8 B</td>
<td>10.6 A</td>
<td>33.0 A</td>
<td>23.6 B</td>
<td>70.5 B</td>
<td>36.7 A</td>
<td>9.1 A</td>
<td>15.4 D</td>
<td>11.3 D</td>
<td>183.7 A</td>
<td>4.2 AB</td>
</tr>
<tr>
<td>P-518 (Check)</td>
<td>55.4 BC</td>
<td>10.2 A</td>
<td>26.0 B</td>
<td>28.5 A</td>
<td>77.1 A</td>
<td>31.9 A</td>
<td>8.7 AB</td>
<td>16.4 C</td>
<td>10.8 E</td>
<td>158.7 C</td>
<td>2.9 B</td>
</tr>
<tr>
<td>C.V %</td>
<td>2.62</td>
<td>2.34</td>
<td>2.53</td>
<td>4.97</td>
<td>1.05</td>
<td>15.27</td>
<td>7.40</td>
<td>1.38</td>
<td>1.88</td>
<td>0.33</td>
<td>20.95</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>2.812</td>
<td>0.408</td>
<td>1.291</td>
<td>1.980</td>
<td>1.349</td>
<td>8.634</td>
<td>1.055</td>
<td>0.441</td>
<td>0.4252</td>
<td>0.967</td>
<td>1.384</td>
</tr>
</tbody>
</table>

TL, B/P, L/P, P/P, LA, GFY, DMY, PL, SP⁻¹ and Grn Y denote tendril length, number of branches plant⁻¹, number of leaves plant⁻¹, number of pods plant⁻¹, leaf area, green fodder yield, dry matter yield, pod length, number of seeds pod⁻¹ and grain yield, respectively.
Regarding pod length highly significant differences were found among variety/lines. Cowpea variety/line CP/V4 produced the highest pod length (19.89 cm) followed by lines CP/V2 (18.12 cm), P-518 (16.37 cm) and CP/V7 (15.39 cm). The lowest pod length was observed in line NO.1 (15.05 cm). Highly significant differences among five different cowpea varieties/lines in respect of number of seeds pod\(^{-1}\) were observed. Cowpea variety/line CP/V2 produced highest number of seeds pod\(^{-1}\) (13.89) followed by CP/V4 (12.44), No.1 (11.78) and CP/V7 (11.33). However, the lowest seeds pod\(^{-1}\) were recorded in line P-518 (10.78). Cowpea variety/line CP/V7 produced the highest 1000 grain weight (183.70 g) followed by CP/V2 (162.70 g), P-518 (158.70 g) and CP/V4 (140.00 g). Whereas line No.1 produced the lowest 1000 grain weight (124.00 g). Cowpea line CP/V2 produced the highest grain yield (4.30 t ha\(^{-1}\)) followed by CP/V7 (4.17 t ha\(^{-1}\)) and NO.1 (3.17 t ha\(^{-1}\)). It was observed that all five cowpea lines were statistically at par with each other. The lowest grain yield was recorded in line P-518 (2.90 t ha\(^{-1}\)). Differences in yield and yield parameters can be attributed to genotypic variations interacting with environment where they are grown (Qamar et al., 1993). This study showed the presence of and the type of genotype environment interactions among the 5 cowpea genotypes affected their yield components. High-yielding varieties/lines with adaptation in the subtropical subhumid Pothwar region were identified.

**Phenotypic Correlation Coefficients among various Parameters**

The phenotypic correlation coefficients among different agronomic and quality traits for cowpea varieties/lines shown in (Table II) are discussed below:

<table>
<thead>
<tr>
<th></th>
<th>TL (cm)</th>
<th>B/P</th>
<th>L/P</th>
<th>P/P</th>
<th>LA (cm(^2))</th>
<th>GFY (t/ha)</th>
<th>DMY (t/ha)</th>
<th>PL (cm)</th>
<th>S/P</th>
<th>1000 grain wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/P</td>
<td>-0.22</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L/P</td>
<td>-0.24</td>
<td>0.71*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P/P</td>
<td>-0.72*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA (cm(^2))</td>
<td>0.01</td>
<td>0.65*</td>
<td>0.22</td>
<td>0.57*</td>
<td></td>
<td></td>
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<tr>
<td>GFY (t/ha)</td>
<td>-0.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMY (t/ha)</td>
<td>0.28</td>
<td>0.57*</td>
<td>0.52*</td>
<td>0.40</td>
<td>0.74*</td>
<td>0.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PL (cm)</td>
<td>0.30</td>
<td>0.09</td>
<td>-0.09</td>
<td>0.03</td>
<td>-0.42</td>
<td>-0.67*</td>
<td>-0.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S/P</td>
<td>1000 grain wt</td>
<td>-0.60*</td>
<td>0.67*</td>
<td>0.85*</td>
<td>0.77*</td>
<td>0.33</td>
<td>0.48</td>
<td>0.41</td>
<td>-0.10</td>
<td>-0.04</td>
</tr>
<tr>
<td>Grn Y (t/ha)</td>
<td>-0.21</td>
<td>0.02</td>
<td>0.51*</td>
<td>0.24</td>
<td>-0.16</td>
<td>0.06</td>
<td>0.27</td>
<td>0.03</td>
<td>0.42</td>
<td>0.46</td>
</tr>
</tbody>
</table>

TL, B/P, L/P, P/P, LA, GFY, DMY, PL, S/P and Grn Y denote tendril length, number of branches plant\(^{-1}\), number of leaves plant\(^{-1}\), number of pods plant\(^{-1}\), leaf area, green fodder yield, dry matter yield, pod length, number of seeds pod\(^{-1}\) and grain yield, respectively.

Table II revealed that tendril length showed a negative but significant correlation with pods plant\(^{-1}\) and 1000 grain weight. Tendril length was positive but non-significantly correlated with leaf area and dry matter yield while it has a negative but non-significant association with number of branches plant\(^{-1}\), number of leaves plant\(^{-1}\), green fodder yield, pod length, number of seeds pod\(^{-1}\) and grain yield. Number of branches plant\(^{-1}\) showed a positive but significant association with leaves plant\(^{-1}\), pods plant\(^{-1}\), leaf area, dry matter yield and 1000 grain weight. Number of branches plant\(^{-1}\) also possessed a positive but non-significant association with green fodder yield, pod length and grain yield. It has a negative but non-significant correlation with number of seeds pod\(^{-1}\).

Number of leaves plant\(^{-1}\) has a positive but significant correlation with dry matter yield, 1000 grain weight and grain yield. It also possessed but non-significant association with pods plant\(^{-1}\), leaf area, green fodder yield and seeds pod\(^{-1}\). Leaves plant\(^{-1}\) have a negative but non-significant correlation with seeds pod\(^{-1}\). Number of pods plant\(^{-1}\) has a positive but significant association with leaf area and 1000 grain weight while a negative but non-significant correlation with seeds pod\(^{-1}\). Pods plant\(^{-1}\) also have positive but non-significant association with green fodder yield, dry matter yield, pod length and grain yield. Leaf area has a positive but significant correlation with dry matter yield and a negative but significant association with seeds pod\(^{-1}\). It also possessed a positive but non-significant association with GFY and 1000 grain weight while a negative but non-significant correlation with pod length, and grain yield.

Green fodder yield possessed a negative but significant association with pod length while negative but non-significant association with seeds pod\(^{-1}\). It also has a positive but non-significant correlation with DMY, 1000 grain weight and grain yield. Dry matter yield has a positive but non-significant correlation with 1000 grain weight and grain yield and a negative but non-significant association with pod length and seeds pod\(^{-1}\). Pod length has a positive correlation with grain yield, but a negative but non-significant association with leaf area and dry matter yield.
but significant correlation with seeds pod$^{-1}$ and a positive but non-significant association with grain yield. It also has a negative but non-significant correlation with 1000 grain weight.

Number of seeds pod$^{-1}$ has a positive but non-significant association with grain yield and a negative but non-significant correlation with 1000 grain weight. However, 1000 grain weight has a positive but non-significant association with the grain yield. Genotypic environmental interactions is the primary source of variation in crops, and the term stability is sometimes used to characterize a genotype, which shows a relatively constant yield, independent of changing environmental conditions (Sabaghnia et al., 2006). On the basis of this idea, genotypes with a minimal variance for yield across different environments are considered stable. The high yield/performance of released varieties is one of the most important targets of breeders; therefore, they prefer a dynamic concept of stability.

CONCLUSION AND RECOMMENDATIONS

It was concluded that the cowpea line CP/V-2 produced the highest green fodder yield (28.50 t ha$^{-1}$) and dry matter yield (6.53 t ha$^{-1}$) than all the other cultivars of cowpea. This study concludes that the cultivar CP/V-2 is high yielding and is recommended for the cultivation under the rainfed conditions of Pothowar region. It is recommended that traits like tendril length, number of branches and number of leaves are important components affecting production and can be exploited for any improvement work in cowpea varieties to improve overall productivity.

REFERENCES


