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# Production potential of gram based intercropping systems under rainfed conditions

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**ABSTRACT :** An experiment was conducted to find out suitable intercrop with chickpea under rainfed condition for maximizing the productivity of intercropping system at Agricultural Research Station, Borwat Farm, Banswara during *Rabi* 2008-09 and 2009-10. Significantly higher chickpea equivalent yield (2523 kg $ha^{-1}$), water use efficiency (420.42 kg ha/cm), net return (Rs.58698/- $ha^{-1}$) and B:C (3.46) were recorded under chickpea + mustard (4:2) rows cropping system over sole chickpea, sole barley, sole durum wheat, sole mustard, chickpea + barley (3:1) rows, chickpea + barley (3:2) rows, chickpea + durum wheat (3:1) rows and chickpea + durum wheat (3:1) rows, respectively. However, it was found at par with chickpea + mustard (4:1) rows cropping system chickpea equivalent yield (2430 kg $ha^{-1}$), water use efficiency (405.0 kg ha/cm), net return (Rs.55675/- $ha^{-1}$) and B:C (3.23) in the pooled analysis.

**KEY WORDS :** Durum wheat, Barley, Intercropping system, Chickpea equivalent yield

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Introduction of suitable pulse crops is also in the national interest which must be popularized. Legume intercropping systems play a significant role in the efficient utilization of resources and cereal legume intercropping is a more productive and profitable cropping system in comparison with solitary cropping by increasing production per unit area. Moreover, various intercropping patterns of legumes and non-legumes (legumes with cereals and oilseeds) have been a central feature of many agricultural systems in India (Sharma *et al.*, 2012). Intercropping establishes a beneficial relationship between component crops, increasing grain yield, stability and efficient resource utilization hence causes the weed suppression (Singh *et al.*, 2014). It is a mixed cropping or polyculture technique in which two or more crops are grown at the same time in the same field (Ofori and Stern, 1987). Intercropping has been a popular farming practice from time immemorial which has received greater attention of the farming community because of its potential advantages, offers utilization of growth resources *viz.*, land, water, nutrients and light by the crops and sustaining productivity. One such system is intercropping of gram based, which is one of the principal food crops of India has long been also a common practice in developing countries. Farmers are motivating to adopt intercropping primarily due to its economic gains, purpose of risk covering practice in tradition bound agriculture to make up a part of crop loss in rainfed and dryland tracts. In intercropping systems when a legume is grown in association with cereals, the nitrogen of the associated crop may be improved by direct nitrogen transfer from legume to cereal (Sharma *et al.*, 2008). Legumes with

their adaptability to different cropping patterns and their ability to fix nitrogen, may offer opportunities to sustain increased productivity. Productivity normally is enhanced by intercropping legumes in cropping systems. Legumes, both alone and as intercrop with cereals, have been advocated not only for yield augmentation but also for maintenance of soil health, particularly in degraded soil (Kumar *et al*., 2003). The competitive behaviour of component crops in different intercropping systems was determined in terms of equivalent yield, land equivalent ratio, relative crowding co-efficient and aggressivity index *etc.* In general intercropping is being looked as an efficient and most economical production system in India as it not only increases the production per unit area and time but also improves the resource use efficiency and economic standard of the growers (Tiwari *et al*., 2002). The present study describes the production potential of gram based intercropping systems under rainfed conditions.

## RESEARCH PROCEDURE

The field experiment was conducted for two consecutive crop season *Rabi*-2008-09 and 2009-10 at Agricultural Research Station, Borwat Farm, Banswara. Ten treatments comprised *i.e.* (sole chickpea, sole barley, sole durum wheat, sole mustard, chickpea + barley (3:1) rows, chickpea + barley (3:2) rows, chickpea + durum wheat (3:1) rows, chickpea + durum wheat (3:2) rows, chickpea + mustard (4:1) rows and chickpea + mustard (4:2) rows) in Randomized Block Design with three replications. Experimental field was well prepared by two ploughing followed by harrowing and cultivator and one planking for uniform levelling were performed for sowing of experiment. The soil was medium in available nitrogen (253 and 251 kg/ha) and phosphorus (49.85 and 48.10 kg/ha) and high in available potassium (326 and 325 kg/ha) during crop season. The crop was sown in first week of October by seed cum fertilizer drill in rows as per treatments in conserved moisture. Full dose of phosphorus, potash and half nitrogen were applied as basal at sowing time, while half dose of nitrogen was given with irrigation or rainfall (mavath). All production and protection measures were applied as per package and practices of the Humid Southern plain Zone of Rajasthan.

## RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

**Yield:**

It is evident from two years pooled data shows that (Table 1) the chickpea equivalent yield was significantly influence under different intercropping system. The maximum chickpea equivalent yield (2523 kg $ha^{-1}$) was recorded under chickpea + mustard (4:2) rows intercropping system over sole chickpea, sole barley, sole durum wheat, sole mustard, chickpea + barley (3:1) rows, chickpea + barley (3:2) rows, chickpea + durum wheat (3:1) rows and chickpea + durum wheat (3:2) rows (1670, 1061, 1160, 1522, 1940, 2121, 2028 and 2241 kg $ha^{-1}$), respectively. However, it was found at par with chickpea

**Table 1: Effect of chickpea based intercropping systems on chickpea equivalent yield and water use efficiency**

| Treatments | Chickpea equivalent yield (kg/ha) | | | Water use efficiency (kg ha/cm) | | |
|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | Pooled | 2008-09 | 2009-10 | Pooled |
| Sole chickpea | 1697 | 1643 | 1670 | 282.83 | 273.83 | 278.33 |
| Sole barley | 1068 | 1054 | 1061 | 178.00 | 175.67 | 176.84 |
| Sole durum wheat | 1167 | 1153 | 1160 | 194.50 | 192.17 | 193.30 |
| Sole mustard | 1570 | 1473 | 1522 | 261.67 | 245.50 | 253.58 |
| Chickpea + barley (3:1) rows | 1970 | 1909 | 1940 | 328.33 | 318.17 | 323.25 |
| Chickpea + barley (4:2) rows | 2127 | 2115 | 2121 | 354.50 | 352.50 | 353.50 |
| Chickpea + durum wheat (3:1) rows | 2080 | 1975 | 2028 | 346.67 | 329.17 | 337.92 |
| Chickpea + durum wheat (4:2) rows | 2230 | 2252 | 2241 | 359.10 | 362.83 | 360.96 |
| Chickpea + mustard (4:1) rows | 2407 | 2453 | 2430 | 401.17 | 408.83 | 405.00 |
| Chickpea + mustard (4:2) rows | 2483 | 2562 | 2523 | 413.83 | 427.00 | 420.42 |
| S.E. $\pm$ | 52 | 59 | 51 | 11.00 | 13.05 | 11.06 |
| C.D. (p=0.05) | 160 | 180 | 154 | 32.45 | 38.17 | 34.20 |

+ mustard (4:1) rows intercropping system (2430 kg $ha^{-1}$) in the pooled analysis. It was mainly due to their greater competitive nature for growth resources. The sole barley produced chickpea equivalent yield 1068 kg per ha the lowest yield might be due to severe crop competition between component crop for nutrients, moisture, light and space. Intercropping between maize - legume systems increases in yield under sole crop was due to the wider space, available soil moisture and reduced the competition of light and nutrients, which probably provided favourable physical environment and helped the plant to grow taller. A similar reduction in number of pods and seed weight per plant of pigeonpea intercropped with greengram and soybean were reported by Tomar *et al*. (1984) and Singh *et al*. (1999). The results of analysed pooled data also reported in the same trend where the increase utilization of applied nutrients due to increased sink capacity and higher combined application of treatments (Tiwari *et al*., 2002).

**Water use efficiency:**

The pooled data shows that (Table 1) the water use efficiency of chickpea based intercropping systems were significantly influence under different intercropping system. The sowing of intercrops, chickpea + mustard (4:2) rows and chickpea + mustard (4:1) rows were found at par with each other in terms of water use efficiency (420.42 and 405.00 kg ha/cm), but both these found significantly superior over sowing of sole chickpea, sole barley, sole durum wheat, sole mustard, chickpea + barley (3:1) rows, chickpea + barley (3:2) rows, chickpea + durum wheat (3:1) rows and chickpea + durum wheat (3:2) rows (278.33, 176.84, 193.30, 253.58, 323.25, 353.50, 337.92 and 360.96 kg ha/cm), respectively. Tomar *et al*. (1984); Singh *et al*. (1999) and Sharma *et al*. (2008). The water use efficiency of chickpea depends on the soil moisture supply and the yield level and there is usually a close linear relationship between the amount of water used and yield (Singh and Bhushan, 1980). Seed yield is also associated with water use efficiency (Dahan and Shibles, 1995).

**Economics:**

An examination of pooled data shows that (Table 2) the significantly higher net return (Rs.58698/- $ha^{-1}$) and B:C (3.46) were observed under chickpea + mustard (4:2) rows intercropping system as compared to sowing of sole chickpea, sole barley, sole durum wheat, sole mustard, chickpea + barley (3:1) rows, chickpea + barley (3:2) rows, chickpea + durum wheat (3:1) rows and chickpea + durum wheat (3:2) rows, respectively. However, it was found at par with chickpea + mustard (4:1) rows cropping system net return (Rs.55675/- $ha^{-1}$) and B:C (3.23) in the pooled analysis. These results are in agreement with the findings of Tomar *et al*. (1984); Singh *et al*. (1999) and Sharma *et al*. (2008). This might be due to difference in yield of gram, which resulted in higher net return in chickpea + mustard (4:2) rows cropping system than in sole crops. Kumar *et al*., 2003 and Sharma *et al*., 2012 also reported similar results.

**Conclusion :**

This study demonstrated the role of additive or superimposed populations and crop arrangement on yield

**Table 2: Effect of chickpea based intercropping systems on economics**

| Treatments | Net return (Rs./ha) | | | B:C | | |
|---|---|---|---|---|---|---|
| | 2008-09 | 2009-10 | Pooled | 2008-09 | 2009-10 | Pooled |
| Sole chickpea | 33910 | 32290 | 33100 | 1.99 | 1.90 | 1.95 |
| Sole barley | 16040 | 15620 | 15830 | 1.00 | 0.98 | 0.99 |
| Sole durum wheat | 18770 | 18350 | 18560 | 1.16 | 1.13 | 1.14 |
| Sole mustard | 32200 | 29290 | 30745 | 2.16 | 1.97 | 2.06 |
| Chickpea + barley (3:1) rows | 41350 | 39520 | 40435 | 2.33 | 2.23 | 2.28 |
| Chickpea + barley (4:2) rows | 46040 | 45680 | 45860 | 2.59 | 2.57 | 2.58 |
| Chickpea + durum wheat (3:1) rows | 44590 | 41440 | 43015 | 2.50 | 2.33 | 2.42 |
| Chickpea + durum wheat (4:2) rows | 49601 | 50261 | 49931 | 2.79 | 2.83 | 2.81 |
| Chickpea + mustard (4:1) rows | 54985 | 56365 | 55675 | 3.19 | 3.27 | 3.23 |
| Chickpea + mustard (4:2) rows | 57513 | 59883 | 58698 | 3.39 | 3.53 | 3.46 |
| S.E.± | 1563 | 1782 | 1539 | 0.11 | 0.12 | 0.10 |
| C.D. (P=0.05) | 4728 | 5416 | 4609 | 0.32 | 0.35 | 0.32 |

of gram and gram based intercropping in the Humid Southern plain Zone of Rajasthan. These findings have significant implications in, chickpea equivalent yield (kg/ha) and best management practices for grain production. Farmers in this agro-ecology can, therefore, superimpose sole crop populations to intercrop gram based intercropping at the chickpea + mustard (4:2) rows for the extra benefits associated with this system.

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