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# Productivity and Profitability of *Rabi* Pigeonpea Increased Through Drip Irrigation with Mulch Under South Gujarat Condition

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***Abstract*** **– A field experiment was conducted during *rabi* seasons of 2011-12 to 2013-14 at Navsari on the productivity and profitability of pigeonpea through drip irrigation and mulch. The experiment was laid out in randomized block design with four replications, keeping four levels of irrigation regimes ($I_1$ : Drip at 0.4 PEF, $I_2$ : Drip at 0.6 PEF, $I_3$ : Drip at 0.8 PEF and $I_4$ : Surface irrigation at 0.8 IW/CPE: 60 mm depth (normal spacing 90 x 20 cm) and three levels of mulch ($M_0$ : No mulch, $M_1$ : Sugarcane trash @ 5 t/ha and $M_2$ : Black plastic mulch with 50µ). The soil of experimental site was clay in texture, having pH 8.0, low in available nitrogen, medium in available phosphorus and high in available potassium. Growing of *rabi* pigeonpea resulted significantly higher grain and stover yields due to 0.8 PEF levels of irrigation. The grain yield registered under 0.8 and 0.6 PEF were 11 and 9 per cent higher over 0.4 PEF level. Yield attributes as well as yields of pigeonpea were also produced significantly higher in black plastic mulch. The interaction effect observed between irrigation and mulch were significant in respect to plant height, yield attributes and yields of pigeonpea. WUE decreased with increase in level of irrigation. Drip irrigation scheduled at lower level (0.4 PEF) recorded higher WUE with 48 per cent water saving. For getting potential production and profit from the *rabi* pigeonpea, scheduling of irrigation at 0.8 PEF through drip with sugarcane trash mulch @ 5 t ha$^{-1}$.**

***Keywords*** **– Drip Irrigation, Pigeon Pea, Plastic Mulch, Water Saving and WUE.**

## I. Introduction

Pigeonpea (*Cajanus cajan* L.) has been considered as second most important crop after chickpea. The demand for pulses is increasing due to increasing population. To meet the demand, pigeonpea productivity has to be increased. Effective management of irrigation water is an important issue in crop production, since irrigation is a precondition for crop growth, development and production per mm of water and productivity per unit area. Drip irrigation is the precise application of irrigation water in the root zone with enhanced water use efficiency (WUE) (Tarawalie *et al*., 2012). There are reports that pigeon pea yield increased tremendously when irrigated through drip method. Similarly, it is anticipated positive effect of mulching on yield of pigeonpea. The practice of mulching in agriculture has been widely used as a management tool. Mulching improves the soil physical condition by enhancing aggregation and conserving soil moisture by increasing infiltration, checking losses by evaporation and run off. It also favourably modifies the soil thermal regime, retards soil erosion and improves soil health. Due to mulching the beneficial effects of plastic mulch for enhanced water and fertilizer utilization and weed control. The polyethylene mulch is very common in high value vegetable crops have been recognized. The plastic mulch increases the soil temperature and moisture of upper layer of soil. Hence, the present study was initiated to study the influence of drip irrigation and mulch on yield and water use efficiency in *rabi* pigeonpea.

## II. Material and Methods

The field experiment was conducted at soil and water management research Farm, Navsari during the *rabi* seasons of 2011-12 to 2013-14. The experiment was laid out in randomized block design with four replications, keeping four levels of irrigation regimes ($I_1$ : Drip at 0.4 PEF, $I_2$ : Drip at 0.6 PEF, $I_3$ : Drip at 0.8 PEF and $I_4$ : Surface irrigation at 0.8 IW/CPE: 60 mm depth (normal spacing 90 x 20 cm) and three levels of mulch ($M_0$ : No mulch, $M_1$ : Sugarcane trash @ 5 t ha$^{-1}$ and $M_2$ : Black plastic mulch with 50µ). The soil of experimental site was clay in texture, having pH 8.0, low in available nitrogen (242 kg ha$^{-1}$), medium in available phosphorus (46 kg $P_2O_5$ ha$^{-1}$) and high in available potassium (368 kg $K_2O$ ha$^{-1}$). Pigeonpea crop was sown in 1st fortnight of November at a spacing of 60 x 20: 120 cm in paired row during all the three years of experimentation and harvested at the physiological maturity stage in the end of May. Recommended doses of fertilizer, *i.e.* 20:40:0 kg NPK ha$^{-1}$ was applied through urea and single super phosphate at time of sowing.

## III. Results and Discussions

### *Effect of Irrigation*

Plant height of pigeonpea increased gradually with decreasing rate up to harvest stage. Irrigation levels resulted in significant variation in plant height to various growth stages through drip irrigation at 0.8 PEF level accounted higher plant height at harvest over rest of the levels. This was also true for number of secondary branches per plant. The differences were significant with regard to yield attributes *viz.,* number of pods and grain weight per plant. The increased in number of pods and grain weight per plant under drip irrigation might be due to adequate water supply at critical growth stages and ultimately reflected in higher uptake of nutrients which might have resulted in better pod development and grain feeling. This finding is conformity with those reported by

Mahalakshmi (2011). The results further indicated that, among different levels of irrigation, 0.8 PEF recorded significantly higher grain yield (1409 kg/ha) and stover yield (3108 kg/ha) as compared to irrigation at 1.0 IW/CPE ratio. The grain yield registered under 0.8 and 0.6 PEF were 11 and 9 per cent higher over 0.4 PEF level. Similar trend was also observed for stover yield of pigeon pea. This implies that drip irrigation favours in terms of growth and yield attributes in comparison to remaining levels of irrigation, due to availability of sufficient moisture supply throughout the entire growth period. These results are in accordance with the findings of Thanki and Solanki (2010) and Mahalakshmi (2011) for *rabi* pigeonpea.

*Effect of Mulch*

Among the different mulch treatments, mulching with black plastic mulch of 25 micron appreciably increased plant height and number of secondary branches of pigeonpea might be due to mulching lead to better plant growth by changing the micro climate through conserving moisture by virtue of reducing evaporation, modifying soil moisture, controlling weeds, thus economizing the use of irrigation water. Moreover, adequate availability of moisture to plant, results in full cell turgidity and eventually higher meristematic activity, leading to more foliage development, greater photosynthetic rate and consequently better plant growth. These results are in conformity with findings of Yadav *et al.* (2006). Number of pods and grain weight per plant as well as grain and stover yields of pigeonpea were also produced significantly higher in black plastic mulch. Black plastic mulch treatment noted 48 per cent higher grain yield over no mulch. The increase in number of pods per plant apparently seems to be due to increase in number of secondary branches per plant which were higher in black plastic mulch. These observations are in accordance with those of Ghose and Biswas (1984).

*Interaction Effect*

The interaction effect observed between irrigation and mulch were significant in respect to plant height, yield attributes and yields of pigeonpea. The plant height was significantly higher with 0.8 PEF and 0.6 PEF with black plastic mulch, while number of pods and grain weight per plant also significantly highest under the same treatment combination *i.e.* 0.8 PEF with black plastic mulch. Remarkably the higher yield of grain (1774 kg $ha^{-1}$) was registered with irrigation level 0.6 PEF + black plastic mulch, which remained at par with 0.4 PEF with plastic mulch and 0.8 PEF with sugarcane trash mulch @ 5 t $ha^{-1}$.

*Water use Efficiency*

The water use efficiency obtained under irrigation levels of 0.4, 0.6, 0.8 PEF through drip and surface irrigation were 3.65, 3.02, 2.45 and 1.90 kg/ha-mm of water used, respectively. This indicated that WUE decreased with increase in level of irrigation. Drip irrigation scheduled at lower level (0.4 PEF) recorded higher WUE of 3.65 kg/ha-mm with 49 per cent water saving.

*Economics*

The economics empathetically establishes the fact that adoption of drip irrigation is more remunerative than surface irrigation. Not only this, but drip irrigation and sugarcane trash mulch also save irrigation water to the extent of 49 per cent as compared to surface method of irrigation. If this saved water is used for irrigation an additional area under *rabi* pigeonpea, the monetary benefit may be still more.

It is concluded that the potential production and profit from the *rabi* season pigeonpea (cv. GT 102) can secured by scheduling of irrigation at 0.8 PEF through drip with sugarcane trash @ 5 t $ha^{-1}$. Due to higher cost of plastic sheet, it was not economical for mulching in pigeopea crop.

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Table 2. Effect of irrigation and mulch on grain yield (kg $ha^{-1}$) of pigeonpea

| Irrigation /Mulch | $M_0$ : No mulch | $M_1$ : Sugarcane trash @ 5 t/ha | $M_2$ : Black plastic |
|---|---|---|---|
| $I_1$ : Drip at 0.4 PEF | 855 | 1300 | 1651 |
| $I_2$ : Drip at 0.6 PEF | 1166 | 1245 | 1774 |
| $I_3$ : Drip at 0.8 PEF | 1198 | 1674 | 1554 |
| $I_4$ : Surface irrigation at 0.8 IW/CPE | 1118 | 1331 | 1435 |
| S. Em.$\pm$ | 49 | | |
| CD (P=0.05) | 138 | | |

Table 1. Growth, yields and economics of *rabi* pigeon pea as influenced by different levels of irrigation and mulch (Pooled of three years)

| Treatment | Plant height at harvest (cm) | Secondary branches per plant | Pods per plant | Grain weight per plant (g) | Yields (kg ha$^{-1}$) | | Income (Rs. ha$^{-1}$) | Water saving (%) | WUE (kg ha$^{-1}$ mm) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Grain | Stover | | | |
| **Irrigation levels (I)** | | | | | | | | | |
| ($I_1$ : Drip at 0.4 PEF | 162 | 13.6 | 210 | 73.43 | 1269 | 2603 | 73488 | 49 | 3.65 |
| $I_2$ : Drip at 0.6 PEF | 164 | 13.6 | 197 | 75.77 | 1395 | 2905 | 79481 | 32 | 3.02 |
| $I_3$ : Drip at 0.8 PEF | 167 | 13.8 | 216 | 82.60 | 1409 | 3108 | 84247 | 16 | 2.45 |
| $I_4$ : Surface irrigation at 0.8 IW/CPE | 156 | 13.1 | 214 | 69.93 | 1294 | 3436 | 77240 | - | 1.90 |
| S. Em.$\pm$ | 1.84 | 0.17 | 4.7 | 1.54 | 28 | 90 | - | - | - |
| CD (P=0.05) | 5.0 | 0.50 | 13.0 | 4.25 | 81 | 253 | - | - | - |
| **Mulch levels (M)** | | | | | | | | | |
| $M_0$ : No mulch | 157 | 12.9 | 192 | 70.62 | 1084 | 2409 | 64606 | - | - |
| $M_1$ : Sugarcane trash @ 5 t/ha | 160 | 13.3 | 207 | 73.24 | 1337 | 3103 | 79022 | - | - |
| $M_2$ : Black plastic sheet (50μ) | 169 | 14.3 | 228 | 82.43 | 1604 | 3526 | 69714 | - | - |
| S. Em.$\pm$ | 1.59 | 0.15 | 4.1 | 1.33 | 24 | 78 | - | - | - |
| CD (P=0.05) | 4.0 | 0.43 | 11.0 | 3.94 | 69 | 219 | - | - | - |