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Research Article

INFLUENCE OF RAINWATER CONSERVATION PRACTICES ON WATER USE AND WATER USE-EFFICIENCY OF PIGEONPEA IN MEDIUM BLACK SOIL UNDER DRY LAND CONDITION

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Abstract: Rainwater conservation have favorable impact on moisture condition and consequently on crop productivity. For pigeonpea (*Cajanus cajan*), the importance of moisture conservation remains high. A field investigation was carried out at All India Co-ordinate Research Project (AICRP), for Dry Land Agricultural Farm, for pigeonpea crop during *kharif* season of 2013 to find out the response of different in-situ rainwater conservation practices on crop productivity. The different moisture conservation treatments imposed were : sowing of pigeonpea crop along the slope (control) (T_1), sowing of pigeonpea crop across the slope (T_2), opening of furrow after two rows across the slope (T_3), opening of furrow after three rows across the slope (T_4), opening of furrow after four rows across the slope (T_5), opening of furrow after five rows across the slope (T_6), opening of furrow after six rows across the slope (T_7). All the conservation treatments were effective in increasing soil moisture level over control, but treatment T_3 proved to be the best. Further treatment T_3 helped to promote the productivity of pigeonpea as evident in significantly higher yield of 3580.5 kg/ha. Significantly higher consumptive use (724.45) and water use efficiency (4.95kg/ha-mm) were also observed with T_3.In-situ rainwater conservation practices found promising for successful cultivation of pigeon pea.

Keywords: *In situ* rainwater conservation practices, pigeonpea, water use efficiency

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Introduction

Pigeon pea (*Cajanus cajan*) Commonly known as red gram is an important legume component in the dryland agricultural production systems. It is mainly grown in the rainy season (June –Nov). Pigeon peas is drought resistant, so can be grown in areas with less than 650 mm annual rainfall. India is the largest producer and consumer of the crop and in its cropping system more spacing gives more yield [1]. It is an ideal crop for mixed and intercropping with other crops. Pigeon peas is a food crop, and a forage/ cover crop. It contains high level of protein and the important amino acids methionine, lysine and tryptophan. About one-third of seed coat is made up of fibre [2]. In combination with cereal, pigeon peas make a well-balanced human food. Hence the greater attention is now being given to managing crop because it is in high demand at remunerative prices. Pigeon pea cultivation created greater awareness and motivated the other farmers to adopt suitable production technology of pigeon pea. Therefore, for enhancing the production and productivity of pigeon pea crop, strategy should be made for getting the more and more recommended technologies to be adopted by the farmers [3].Water use efficiency (WUE) is a measure of a crop's capacity to convert water into plant biomass or grain. It includes the use of water stored in the soil and rainfall during the growing season so it is essential to conserve the natural resources, soil and water, which is the production base of all agricultural systems and its conservation is one of the pillars of sustainability. It is therefore the prime responsibility to conserve soil and water, which is main capital of the farmer as well as the nation. If rainwater not conserved properly will not only cause scarcity and famine but also wash away the soil, which is a valuable national asset. If the run-off water is stored in the land itself, it would be available to plants when there is a water shortage [4]. The *in situ* moisture conservation practices mainly helpful in conservation of rain water and ensure uniform distribution of moisture in the inter-terraced area. The basic role of *in situ* moisture conservation is to stretch the infiltration opportunity time for increased rainfall use efficiency and drain out excess rainfall safely out of the crop fields [5]. Soil moisture management is, therefore, a key factor when trying to enhance agricultural production by improving the capture of rainfall, the availability of water in the soil and water use efficiency in rain fed agricultural lands. Looking to the need of moisture conservation, the present study was undertaken to assess the response of in-situ rainwater conservation measures on productivity of pigeon pea.

Materials and Methods

The field investigation was conducted at All India Co-ordinated Research Project (AICRP) for Dry Land Agricultural Farm, VNMKV, Parbhani of Maharashtra state for Pigeonpea (BDN 2009) crop during kharif season of 2013. Geographically Parbhani is situated at 170 36' North latitude and 760 47' East longitude with an elevation of 406 m above mean sea level. The experiment was conducted in medium black soil. The soil type ranges from medium to deep black with pH of 8.2 and bulk density 1.37 kg/m^{-3}. The experiment consisted of seven treatments with three replications. The treatments included sowing of pigeon pea crop along the slope (control) (T_1), sowing of pigeon pea crop across the slope (T_2), opening of furrow after two rows across the slope (T_3), opening of furrow after three rows across the slope (T_4), opening of furrow after four rows across the slope (T_5), opening of furrow after five rows across the slope (T_6), opening of furrow after six rows across the slope (T_7). The experiment was laid out in an area of 48×20m in a Randomized Block Design with 90×20cm plant spacing. The observations were recorded on different growth stages of pigeon pea *i.e*., 0-45 days: Branching stage, 45-110 days : Flowering stage, 110- 120 days : 50% Flowering stage, 120-

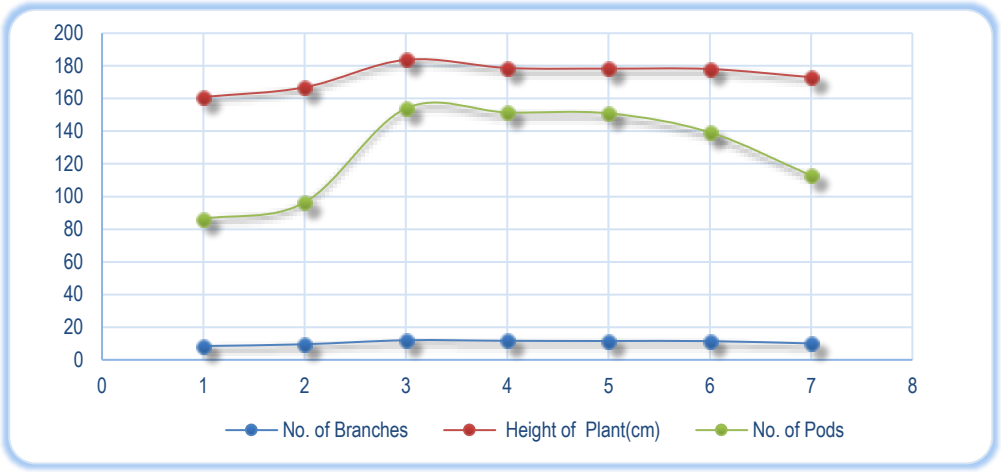

Fig-1 Effect of in-situ rainwater conservation practices on plant growth

140 days : Pod formation, 140- 160 days : Grain development, 160-180 days : Maturity stage. As per treatments, furrows were opened with bullock drawn plough after 45 days of sowing. The crop was cultivated with recommended package of practices and harvested on 21st January 2014. Data on yield and yield attributes were recorded as follows:

Plant Growth Attributes

Plant heights, number of branches, number of pods were recorded during harvesting by selecting five plants randomly from each treatment.

Total seed yield

Replication wise plants and seed weight per plot was recorded after threshing and converted to total yield(kg ha^{-1}) from each treatment.

Soil water content

Soil water content (per cent) in the profile was worked out by water content in the soil profile layers, *i.e.*, 0-15, 15-30 and 30-45cm by gravimetric method at the time of sowing and harvesting of crop. The soil water content was then converted on volume basis(mm) as

$$D = \sum (Mi \div 100)\ DiAi + ER$$

Where, Mi = soil water content(%) of i^{th} layer, Di = soil depth of i^{th} layer, Ai = Apparent specific gravity of i^{th} layer. The difference in soil water content at sowing minus soil water content at harvest was computed for consumptive use (CU) by the crop. Rainfall received during crop season was accounted for crop consumptive use.

Rainwater use efficiency

Rain water use efficiency (RWUE) (kg $ha^{-1}mm^{-1}$) was worked out by dividing the seed yield (kg ha^{-1}) by crop consumptive use (mm). Plant growth attributes *i.e.*, plant height, number of branches, number of pods were recorded during harvesting by selecting five plants randomly from each treatment. The recorded data was analyzed statistically with MAU-STST software.

RESULTS AND DISCUSSION

Rainfall Distribution

The amount and distribution of rainfall during the experimentation period (2013-2014) is depicted in Table 1. The higher amount of rainfall during *kharif* - 2013resulted in better crop performance. As per rainfall data recorded by central observatory of VNMKV, Parbhani station the total rainfall during the period was 1178.1mm. Out of total rainfall received during *kharif* 2013-2014 the effective rainfall was 774.1mm with 58 rainy days.

Plant Growth

Highest number of branches was recorded in opening of furrow after two rows (T_3) (*i.e.*, 12.00). It was found that 41.83 per cent higher number of branches was recorded in treatment T_3 than the control treatment T_1.

Yield and yield attributing parameters

Significantly the higher yield due to moisture conservation practice was evident in dry land pigeon pea. The data indicated (Table 3) higher yield (3580.5 kg/ha) with opening of furrow across the slope after two rows. On the contrary the yield obtained in sowing along the slope (control) was reduced to near 11.7 per cent. Allolli et.al (2007) reported that moisture conservation practices (ridges and furrow + mulch) promote the higher yield as compared to flat bed [6].

Table-1 Monthly rainfall during kharif 2013-2014

Month	Rainfall(mm)
June	206.5
July	409.2
August	167.6
September	236.9
October	117.3
November	14
December	26.6
Total	1178.1

Table-2 Effect of in-situ rainwater conservation practices on plant growth

Treatment	No. of Branches	Height of Plant (cm)	No. of Pods
T_1	8.46	160.93	86.26
T_2	9.53	166.87	96.4
T_3	12	183.73	153.93
T_4	11.66	178.73	151.47
T_5	11.53	178.33	150.93
T_6	11.46	178.07	139.27
T_7	10	173.07	112.87
Mean	10.66	174.25	127.3
SE±	1.03	5.55	17.27
CD at 5% level	3.17	1.7	53.13

Table-3 Effect of rainwater conservation practices on consumptive use, seed yield, water use efficiency in pigeon pea crop during *Kharif*- 2013.

Treatments	Consumptive use (mm)	Seed yield (kg/ha)	Water use efficiency (kg/ha-mm)
T_1	697.67	2472.0	3.54
T_2	723.64	2700.0	3.7
T_3	724.45	3580.5	4.9
T_4	719.41	3416.6	4.7
T_5	716.75	3277.7	4.5
T_6	716.68	2888.8	4.03
T_7	716.47	2722.0	3.8
Mean	716.44	2880.5	4.1
SE±	1.54	337.9	0.10
CD at 5% level	4.7	103.9	0.32

Consumptive use and rain water use efficiency

Opening of furrow across the slope after two rows was effective for in-situ rain water conservation and resulted in higher soil water availability in the soil profile

as indicated by higher consumptive use of water (724.45mm). Opening of furrow after two rows increased consumptive use of water by 26.78 mm over sowing along the slope *i.e.*, control T_1. This has led to increased rain water use efficiency to 1.51 kg/ha-mm over control. Rao *et al* (2010) reported that among all in-situ rainwater conservation practices, significantly higher mean water use efficiency was recorded in IPRWH for seed 4.07 kg $ha^{-1}mm^{-1}$ as compared to 2.82 kg $ha^{-1}mm^{-1}$ observed under control [7]. This was attributed to increase in seed yield with increased soil water content under rainwater conservation practice [8].

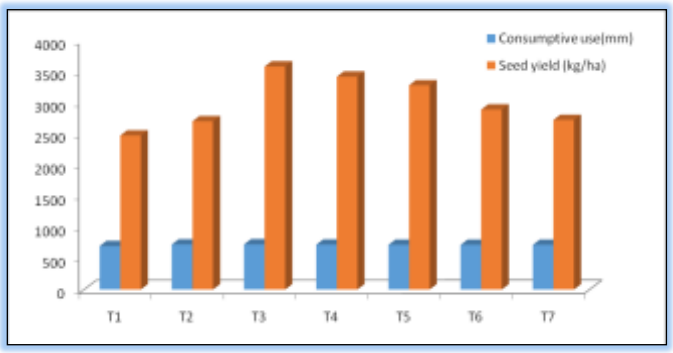

Fig-2 Mean effect of rainwater conservation practices on consumptive use, seed yield in pigeon pea crop during *Kharif*- 2013.

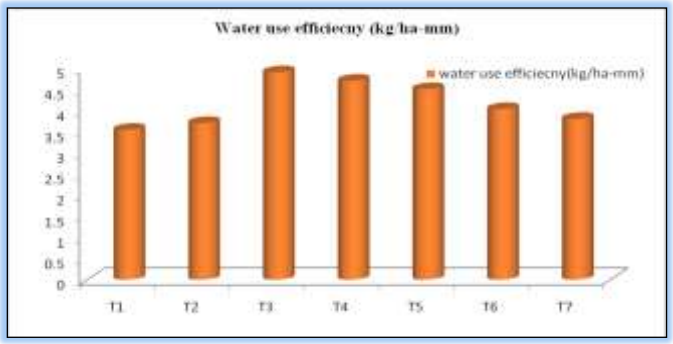

Fig-3 Effect of rainwater conservation practices on water use efficiency in pigeon pea crop during *Kharif*- 2013.

Conclusions

All in-situ rainwater conservation practices, in general, had favorable effect on growth of pigeon pea. Opening of furrow across the slope after two rows in pigeon pea imparted significant effect on moisture conservation in the root zone of the pigeon pea growth and development for getting higher yield (3580 kg/ha). Among the in-situ rainwater conservation practices, significantly higher mean consumptive use (724.45mm) and rain water use efficiency (4.95 kg/ha-mm) was also recorded in opening of furrow after two rows (T_3). Therefore, opening of furrows across the slope after two rows in pigeon pea ensured successful pigeon pea production under rainfed condition.

Application of research: This study is helpful to the pigeonpea growing farmers as well as different Project Implementing Agencies for improving the productivity of pigeonpea.

Research Category: Soil and Water Conservation Engineering

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References

[1] Tegegne F., Singh S.P., Duseja D., Ekanem E. and Bullock R. (2012) *Journal of Food Distribution Research*, 43 (1), 90-95.
[2] Saxena K.B., Vijaya Kumar R.K. and Sultana R. (2010) *Health, Vol.2, No.*11, 1335-1344.
[3] Singh S.K., Singh Dhananjai, Singh Archna and Singh D.K. (2016) *International Journal of Agriculture Sciences*, 8(28), 1600-1602.
[4] Morey A., Dhurve B., Haste V. and Wasnik B. (2016) *International Research J. of Engineering and Tech.*, 3 (4).
[5] Sharma A. and Guled M. B. (2012) *Karnataka J. Agric. Sci.*,25 (1),18-24.
[6] Allolli T.B., Hulihalli U.K. and Athani S.I. (2007) *Influence of in situ moisture conservation practices on the performance of dry land chili. Department of Horticulture University of Agricultural sciences, Dharwad - 580 005, Karnataka, India*.
[7] Rao S.S., Regar P.L. and Singh Y.V. (2010) *Effect of in-situ rainwater conservation practices in sorghum (Sorghum bicolor) under rainfed condition in arid region. Central Arid Zone Research Institute, Regional research Station, Pali-Marwar* 306-401.
[8] Brhane G., Charle S.W., Mamo, M., Gebrekidan H. and Belay A. (2006) *Agrin. J.*, 98, 124-128.