Article AR2034a

DOI: HTTPS://DOI.ORG/10.23910/IJBSM/2019.10.6.2034a

International Journal of Bio-resource and Stress Management

December 2019

Print ISSN 0976-3988
Online ISSN 0976-4038

IJBSM 2019, 10(6):593-596

Research Article

Natural Resource Management

Yield Maximization in Pigeonpea through Various Crop Management Practices in Humid South Eastern Plain Zone of Rajasthan

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Open Access

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Citation: Meena et al., 2019. Yield Maximization in Pigeonpea through Various Crop Management Practices in Humid South Eastern Plain Zone of Rajasthan. International Journal of Bio-resource and Stress Management 2019, 10(6):593-596. HTTPS://DOI.ORG/10.23910/IJBSM/2019.10.6.2034a

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

Acknowledgement: The authors are highly thankful to All India Coordinated Research Project on Pigeonpea, ARS, Kota for providing all facilities to conduct the research work.

Abstract

A field experiment was conducted during *kharif* 2014-15 to 2016-17 at ARS, Kota (Rajasthan) to maximizing the yield of pigeonpea through various crop management practices in humid south eastern plain zone. The experiment was laid out in RBD comprising eight treatments *viz*., INM (FYM @ 5 t ha^{-1}+RDF *i.e.* NPKSZn+seed treatment with sodium molybdate @ 4 g kg^{-1} seed), IWM (Pendimethalin 0.75 kg ha^{-1} at 3 DAS+Imazethapyr @ 100 g ha^{-1} at 10-15 DAE of weeds+1 HW/1 inter cultivation at 50 DAS), IPM (Indoxacarb 15.8% EC at the time of flowering @ 375 ml ha^{-1}+one systemic insecticide spray 15 days after 1st spray), INM+IWM, INM+IPM, IWM+IPM, INM+IWM+IPM and Control (Farmer's practice) with three replication. On pooled data basis, the result showed that the significant reduction in weed count (No/m^2) and dry weight (g/m^2) were recorded under INM+IWM+IPM crop management practices, which was statically at par with INM+IWM and IWM+IPM crop management practices. Further results revealed that the significant increase in plant height, yield attributes, grain (1643 kg ha^{-1}), stalk (2720 kg ha^{-1}) and biological yield (4337 kg ha^{-1}) of pigeonpea were obtained and net return (₹ 5219 ha^{-1}) with B:C ratio (2.10) were fetched under INM+IWM+IPM crop management practices, respectively, as compared to the farmers practices, which was found statistically at par with INM+IWM and IWM+IPM crop management practices.

Keywords: Vermicompost, pendimethalin, imazethapyr, indoxacarb, INM, IWM, IPM

1. Introduction

The pigeonpea is the most important pulse crop in India. Pigeonpea (*Cajanus cajan* (L.) Millsp.) commonly known as Redgram, Tur, Arhar etc., is an erect and short-lived perennial shrub legume. It is mainly eaten in the form of split pulse as 'dal'. Seeds of arhar are also rich in iron, iodine, essential amino acids like lycine, threonine, cystine and arginine etc. Owing to soil enriching qualities, it fits into several cropping systems for soil enrichment and as a source of additional income. Vegetative growth is initially slow and seedlings emerge 2-3 weeks after sowing. Physiological growth picks up in about 2-3 months and plants start flowering within 56-210 days after sowing (DAS) with maturity range from 95 to 256 days.

India produces 81% and consumes 90% of pigeonpea in the World. Economically it is the second most important pulse crop after chickpea in India accounting for about 20% of total pulse production. In India,

Article History

RECEIVED in 08th September 2019 RECEIVED in revised form 23rd November 2019 ACCEPTED in final form 23rd December 2019

pigeonpea was cultivated on 3.75 m ha area with 2.46 mt of production at an average productivity of 6.56 q ha^{-1} (DAC & FW, 2015-16). In Rajasthan, pigeonpea was cultivated on 1.78 m ha area with 1.94 mt of production at an average productivity status of 10.88 q ha^{-1} (Anonymous, 2016-17). There are several constraints in the pigeonpea cultivation. One of them is application of fossil based inputs like imbalance chemical fertilization, pesticides and herbicides due to its adverse impact on productivity at national level which is very low 675 kg ha^{-1} (Veeranna et al., 2017). Weed infestation not only reduce the crop yield, but also decrease the quality of produce and often weeds harbour insect and disease causing organisms (Channappagoudar and Biradar, 2007). The high cost of chemical fertilizers, the low purchasing power of small and marginal farmers and their adverse effect on environment has led to look for some alternative strategies. The low yield of pigeonpea is not only due unavailability of good quality seeds but due to faulty agro techniques, where soil moisture plays a very critical role for flowering and pod development which leads to reduction in grain yield (Sharma et al., 2012). The pigeonpea growers face several constraints which come in the way of boosting pigeonpea production are the method of planting and plant population. Further water stress, non-availability of suitable varieties, inadequate transfer of technology, problems of weeds, insect and disease are the major constraints for reduction of yield in pigeonpea. Sachan *et al*. (1994) have reported that pigeonpea is attacked by nearly 250 species of insect worldwide belonging to 8 orders and61 families though relatively few cause serious yield losses. Integrating inorganic, organic and bio-fertilizers are essential in realizing the higher pigeonpea yield and reducing cost of production was reported by Reddy et al. (2011).

Hence, the present investigation was undertaken to study "Yield Maximization in Pigeonpea through Various Crop Management Practices in Humid South Eastern Plain Zone of Rajasthan."

2. Materials and Methods

A field experiment was conducted at Agricultural Research Station, Ummedganj, Kota (Rajasthan), India during *kharif* 2014-15 to 2016-17 to maximizing the yield of pigeonpea. through various crop management practices. This station is situated at 75°.25' E longitude 25°.13' N latitude, and an altitude of 258 m above mean sea level. The soil of experimental field was clay loam in texture, alkaline in reaction, medium in organic carbon (0.56, 0.52 and 0.54%), medium in available nitrogen (353.00, 343.0 and 338.0 kg ha^{-1}), medium in phosphorus (24.92, 23.75 and 24.52 kg ha^{-1}), high in available potash (410.0, 395.0 and 399.0 kg ha^{-1}), respectively.

The experiment was laid out in RBD comprising eight treatments*viz*., INM (FYM @ 5 t ha^{-1}+RDF *i.e.,* NPKSZn+seed treatment with sodium molybdate @ 4g kg^{-1} seed), IWM (Pendimethalin 0.75 kg ha^{-1} on 3 DAS+Imazethapyr @ 100 g ha^{-1} on 10-15 DAE of weeds+1 HW on 50 DAS), IPM (Indoxacarb 15.8 % EC at the time of flowering @ 375 ml ha^{-1}+dimethoate 30 EC @1000 ml ha^{-1} spray 15 days after 1st spray), INM+IWM, INM+IPM, IWM+IPM, INM+IWM+IPM and Control (Farmer's practice) with three replication.The seed treated with *Rhizobium*+*Pseudomonas* bacteria+Plant growth promoting *Rhizobium* were common to all treatments except control (Farmer's practice). In all three years the sowing of experiment was completed after onset of monsoon (up to mid July) which harvested in January month of year.

The crop was raised under *rainfed* condition with 60 cm as inter row spacing and 20 cm is followed as intra row spacing. Data were recorded on weed dynamics (*i.e.* weed count and weed dry weight) and biometrical characters viz; plant height (cm), number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, test weight (g), biological and seed yield (kg ha^{-1}), the statistical analysis were calculated as per the standard procedures.

3. Results and Discussion

3.1. Weed dynamics

It is clearly shown in (Table 1) the impact of combined application of different crop management practices significantly influence the weed count and weed dry weight as compared to farmer practices. On pooled basis, the highest significant decrease in weed count (3.47 No/m^2) and Weed dry weight (23.87 g m^{-2}) were reported under combined application of INM+IWM+IPM crop management practices, which was statically at par with INM+IWM and IWM+IPM crop management practices, however, these crop management practices significantly decreased weed count and weed dry weight over rest of the crop management practices during investigation. This was due to effectively minimizing of weed population by hand weeding in the initial stage of crop growth, inter-cultivations and chemical weed control during crop growth period. Similar result also reported by Moasunep et al. (2014) with the application of different herbicide and hand weeding at critical stage of crop growth period. Singh et al. (2010) also reported that application of imazethapyr @ 75 g ha^{-1}+Quizalofop ethyl @ 50 g ha^{-1} on 15 DAS+one hand weeding on 50 DAS/inter cultivation recorded lowest dry weights of weeds in pigeonpea crop. Singh et al. (2006) who observed that application of different herbicides and fertility levels reduced the dry matter of weed in soybean crop.

Kalhapure et al. (2011) also reported that application of Imazethapyr 0.100 kg ha^{-1}+quizalofop-ethyl 0.075 kg ha^{-1} as PoE was recorded highest 100 seed weight, seed yield and straw yield per hectare in soybean crop.

3.2. Growth and yield attributes

On pooled data basis results present in Table 1, revealed that the combined application of different crop management practices significantly influence the growth, yield attributes and yield of pigeonpeaas compared to rest of the crop management practices and farmer's practices. The combined

Table: 1: Effect of integrated crop management on weed dynamics, growth parameters and yield attributes of Pigeonpea (pooled data)

Treatment	Weed count (Nos m^{-2})	Weed dry weight (g m^{-2})	Plant height (cm)	Branch-es $plant^{-1}$	Pods $plant^{-1}$	Seeds pod^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	Bio-logical yield (kg ha^{-1})	Net return (₹ ha)	B: C ratio
INM (FYM@ 5 t ha^{-1} or Vermicompost @ 2.5 t ha^{-1}+RDF i.e. NPKS Zn)	8.62	190.90	171.2	16.5	174.4	4.1	103.0	1127.67	2999.67	37648.00	2.29
IWM(Pendimethalin 0.75 kg ha^{-1} on 3DAS+Imazathapyr @ 100 g ai ha^{-1} on 10-15 DAE of weeds+1 HW on 50 DAS/1 inter cultivation on 50 DAS)	4.43	40.02	163.1	18.0	179.4	4.2	102.2	1346.67	3560.33	48933.70	2.69
IPM (Indoxacarb 15.8% EC at the time of flowering @ 375 ml/ha+one systemic insecticide spray 15 days after 1st spray)	8.86	194.55	161.4	15.4	169.6	3.9	102.0	1074	2836.33	37430.00	2.50
INM+IWM	3.67	24.88	196.0	19.2	206.5	4.4	105.0	1529.67	4053.33	49836.70	2.09
INM+IPM	8.53	186.85	191.9	18.3	195.4	4.2	104.6	1292.33	3468.33	42697.70	2.18
IWM+IPM	4.05	37.08	186.9	17.3	189.2	4.2	104.2	1491.33	3949.67	50087.30	2.21
INM+IWM+IPM	3.47	23.87	200.7	20.6	223.1	4.5	105.7	1643	4337.00	52191.30	1.95
Control (Farmer's practice)	9.34	215.53	149.2	13.0	144.6	3.5	97.6	915	2446.00	29822.70	2.03
SEm±	0.27	5.44	5.02	0.73	6.10	0.10	1.69	50.73	123.91	2595.79	0.11
C D (*p*=0.05)	0.77	15.52	14.31	2.08	17.42	0.28	4.81	144.75	353.57	7406.96	0.31

Sale price ₹ 40 kg^{-1} INR during 2014-15 and ₹ 60 kg^{-1} INR during 2015-16, respectively

application of INM+IWM+IPM crop management practices significantly influenced the plant height (200.7 cm), yield attributes (*i.e.* branches $plant^{-1}$ (20.6), pods $plant^{-1}$ (261.4), seeds pod^{-1} (4.5), test weight (105.7), grain (1643 kg ha^{-1}), stalk (2720 kg ha^{-1}) and biological yield (4337 kg ha^{-1}) of pigeonpea, which was found at par with INM+IWM and IWM+IPM crop management practices, however, these crop management practices significantly enhanced growth, yield attributes and yield of pigeonpea over rest of the crop management practices during all the years of investigation. These results are in close conformation with the finding of Tomer (2010) who reported that integrated nutrient management+integrated pest management practices recorded highest grain yield of pigeonpea. While, farmer's practice recorded significantly lower yield due to partial weed infestation, more pest and disease incidence during crop growth resulting in low nutrient uptakeby the crop. This shows that the reduction in yield was apparently due to reduction in growth and yield components caused by some weed infestation and relatively more pest and disease incidence. Reddy et al. (2011) found the similar result by the integrated nutrient management for increase in yield attributes because of increase in nutrient up take correspondingly increase the yield attributes. Pandey et al. (2013) also reported similar results with combine application of FYM @ 5.0 t ha^{-1} or vermicompost@ 2.5 t ha^{-1} with 100 % RDF proved equally effective for enhancing the grain yield of pigeonpea. Kalhapure et al. (2011) also reported that application of Imazethapyr 0.100 kg ha^{-1}+quizalofop-ethyl 0.075 kg ha^{-1} as PoE was recorded highest 100 seed weight, seed yield and straw yield per hectare in soybean crop. Therefore, higher grain yields in INM+IPM+IWM treatments may be due to better weed control as reflected in lower weed biomass, sufficient nutrient supply by integrated nutrient management, timely and effective pest management trough integrated pest management and better plant growth and yield attributes.

3.3. Economics

Higher net income ₹ 52191.30 ha^{-1} was obtained with combined

application of INM+IWM+IPM management practices followed by IWM+IPM (₹ 50087.30 ha^{-1}) and INM+IWM (₹ 49836.70 ha^{-1}) The higher net return was mainly attributed to higher grain yield. The lower net return (₹ 29822.30 ha^{-1}) was recorded with farmer's practices, mainly owing to lower grain yield (915 kg ha^{-1}). These results are in close conformation with the finding of Kantharaju et al. (2011).

4. Conclusion

Crop management practices i.e. INM+IWM+IPM gave maximum pigeonpea grain yield and net return being at par with INM+IWM and IWM+IPM.

5. Acknowledgement

The authors are highly thankful to All India Coordinated Research Project on Pigeonpea, ARS, Kota for providing all facilities to conduct the research work.

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