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Jitender
Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Rajbir Garg
Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Virender Singh
Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Jitender
Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Effect of cropping system and weed management on WCE and crop equivalent yield in pigeonpea + greengram

Jitender, Rajbir Garg and Virender Singh

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Abstract
Pigeonpea (*Cajanus cajan*) is one of the most important pulse crops of India after chickpea also known as Arhar, Red gram, Tur, No eye pea, and Congopea. Rainy season, slow initial growth and sowing at wider spacing of pigeonpea encourage rapid growth and severe infestation of weeds. Greengram (*Vigna radiata*) is another important pulse crop. Pigeonpea being long duration, wide spaced, slow growing at early stage offers a great scope for intercropping short duration, fast growing and non-competitive intercrops with dissimilar growth habit. The field experiment was conducted at Research farm, Department of Agronomy, CCS HAU, Hisar during *kharif* season of 2021 & 2022. The experiment was conducted in a split plot design having 3 replications; each having two main plot treatments of cropping systems and 14 sub plot treatments of weed management. Four pre-emergence and two post emergence herbicides were evaluated. Combination of hoeing following the pre-emergence herbicides and two hoeings were also included. Sequential combination of pre and post emergence herbicides were also tested. Weedy check and weed free were maintained throughout the experiment. Results of experiment revealed that application of pendimethalin + imazethapyr (RM) @ 1000 g/ha was most effective pre-emergence herbicide among the tested herbicides and yielded highest crop equivalent yield and weed control efficiency (wce). Hoeing at 45 DAS following the pre-emergence herbicides further increased the crop equivalent yield and wce. Post emergence application of herbicides also provided satisfactory results. Highest crop equivalent yield and wce was recorded under two hoeings closely followed by pendimethalin + imazethapyr (RM) @ 1000 g/ha *fb* hoeing at 45 DAS.

Keywords: Crop equivalent yield, wce, herbicides, hoeing, pigeonoea, greengram

Introduction
Pigeonpea (*Cajanus cajan*) is one of the most important pulse crops of India after chickpea also known as Arhar, Red gram, Tur, No eye pea, and Congopea (Prasad *et al*., 2006) [3] belongs to genus *Cajanus* and species *cajan* under family Leguminoseae. It is a good source of rich amino acids, vitamins and minerals. Rainy season, slow initial growth and sowing at wider spacing of pigeonpea encourage rapid growth and severe infestation of weeds. Weeds can cause seed yield losses up to 80% (Talnikar *et al*., 2008) [6]. Manual and mechanical methods of weed control are quite effective, but they are costly and time consuming (Ram *et al*., 2011) [10]. Also due to frequent rains it becomes difficult to do hand weeding at proper time in pigeonpea. Chemical control of weeds is need of the hour. Pre-emergence herbicides checks the weed growth initially during the critical period of weed growth in pigeonpea.
Greengram (*Vigna radiata*) is another important pulse crop. Its seed contains about 24% protein (Poehlman, 1991) [2]. Weed management is an important factor for enhancing the productivity of greengram. Yield losses in greengram due to weeds have been estimated to range between 30-50% (Kumar *et al*., 2004) [1]. Recent researches have shown the feasibility of intercropping of short duration *Kharif* legumes with pigeonpea. Pigeonpea being long duration, wide spaced, slow growing at early stage offers a great scope for intercropping short duration, fast growing and non-competitive intercrops with dissimilar growth habit.
Research on weed management in intercropping system has been limited. Application of pendimethalin provides excellent control of weeds and produces comparable seed yield of component crops in pigeonpea intercropping system with green gram, black gram and cowpea with weed free conditions (Singh and Tewari, 1992) [5].
Hand weeding twice (15 and 30 DAS) followed by hand hoeing (30 and 42 DAS), pendimethalin (1.0 kg/ha) and fluchloralin (1.0 kg/ha) each followed

by two hoeing at 30 and 42 DAS are effective in reducing weed biomass, higher yields of pigeonpea, better weed control efficiency and higher returns in pigeonpea and groundnut intercropping (Vijaykumar *et al*., 1995) [9]. The information on weed management practices in pigeonpea + greengram intercropping are very meagre. Therefore efforts are needed to workout suitable weed management practices in pigeonpea + greengram intercropping system.

Materials and Methods

Field experiment was conducted at Research farm, Department of Agronomy, CCS HAU, Hisar during *kharif* season of 2021 & 2022. The experimental soil was alkaline. Soil was low in organic carbon, available nitrogen and available phosphorous; high in available potash. Experiment was laid out in Split Plot Design (SPD) having 2 main plot and 14 sub plot treatments, each replicated thrice. Pigeonpea variety Manak and greengram variety MH 421 was sown. Crop was raised with recommended package of practices except weed management. Treatments of weed management were applied at different times in different plots of size 10.2 m x 2.4 m. Main plot treatments consist of sole pigeonpea and pigeonpea + greengram. In sub plot, treatments consist of 4 pre-emergence herbicides *viz*. pendimethalin @ 1000 g/ha, imazethapyr @ 100 g/ha, pyroxasulfone @ 127.5 g/ha and pendimethalin + imazethapyr (RM) @ 1000 g/ha; hoeing at 45 DAS following the aforesaid herbicides; sequential application of pendimethalin @ 1000 g/ha (PRE) *fb* imazethapyr @ 100 g/ha (POE); two post emergence treatments propaquizafop + imazethapyr @ 125 (50 + 75) g/ha & imazethapyr @ 100 g/ha; two hoeings at 25 & 45 DAS; rest two were weedy check and weed free. Weed control efficiency (%) is the efficiency with which weeds are controlled in terms of dry matter accumulation in treated plot compared to unweeded control plot and expressed as percentage. Weed control efficiency (%) was computed by using formula (Kondap and Upadhyay, 1985) [11]:

$$WCE\ (\%) = \frac{Wc - Wt}{Wc} \times 100$$

Where,
Wc = Dry matter of weeds in weedy check
Wt = Dry matter of weeds in treated plot

Statistical analysis of data

All the experimental data for various crop parameters were statistically analysed by online computer programme OPSTAT (Sheoran *et al*., 1998) [4].

Results and Discussions

Crop equivalent yield

The data pertaining to equivalent yield of pigeonpea crop is given in Table 1 for both the years of study. The intercropping of greengram with pigeonpea contributed for additional yield of greengram but caused nominal reduction in pigeonpea grain yield. The cumulative effect as evident from the observations showed that the equivalent yield of pigeonpea increased from 1613 kg/ha in sole crop to 1885 kg/ha in intercropping system during 2021. Among the various weed management treatments, highest equivalent yield of pigeonpea was recorded in weed free and least values were recorded in weedy check. The equivalent yield of pigeonpea recorded in the treatment having two hoeings at 25 and 45 DAS and in the treatment having the application of pendimethalin + imazethapyr (RM) @ 1000 g/ha as PE *fb* one hoeing at 45 DAS was statistically at par with the weed free. Similar results were reported by Tomar *et al*. (2004) [8].

Weed control efficiency

The data pertaining to the weed control efficiency is tabulated in Table 2. Weed control efficiency increased with time and reached to maximum at 60 DAS; it started declining towards maturity of crop *i.e.* 90 DAS and at harvest. Lower weed control efficiency was observed under the sole pigeonpea as compared to pigeonpea + green gram intercropping system at all the stages of crop growth. Weed free treatment gave highest weed control efficiency (100%) at each stage of observation taken during both the years. WCE > 90% was recorded under two hoeings (25 and 45 DAS) at 30 and 60 DAS. This treatment gave WCE > 85% at later stages during both the years. Weed control efficiency represents efficiency of weed control by treatment compared to weedy check. The highest weed control efficiency (WCE) was recorded in weed free treatment. This might be due to effective weed control achieved under efficient method of weed management in term of reduced biomass of weeds and higher weed control efficiency. Almost similar results were also reported by Tarafder (2016) [7].

Table 1: Effect of cropping system and different weed management practices on crop equivalent yield

Treatment			Crop equivalent yield	
Cropping system			**2021**	**2022**
Sole pigeonpea			1613	1542
Pigeonpea + greengram			1885	1842
SE m±			18	21
CD			119	135
Weed management practices				
Herbicide	**Dose (g/ha)**	**Time of application**		
PMN	1000	PE	1417	1397
IMZ	100	PE	1645	1596
PXN	127.5	PE	1614	1565
PMN + IMZ (RM)	1000	PE	1817	1743
PMN *fb* one hoeing	1000	PE, 45 DAS	1837	1777
IMZ *fb* one hoeing	100	PE, 45 DAS	1978	1919
PXN *fb* one hoeing	127.5	PE, 45 DAS	1901	1825
PMN + IMZ (RM) *fb* one hoeing	1000	PE, 45 DAS	2036	1993
PMN *fb* IMZ	1000 & 100	PE, POE	1751	1699
IMZ	100	POE	1574	1500
Propaquiza fop + IMZ (TM)	125 (50+75)	POE	1750	1686

Two hoeings	-	25 & 45 DAS	2118	2057
Weed free	-	-	2181	2106
Weedy check	-	-	868	828
SE m±			44	43
C.D. (p=0.05)			125	123

Table 2: Effect of cropping system and different weed management practices on weed control efficiency

Treatment			**30 DAS**	**60 DAS**	**90 DAS**	**At harvest**				
Cropping system			2021	2022	2021	2022	2021	2022	2021	2022
Sole pigeonpea			67.36	67.56	71.83	71.18	66.80	66.62	65.29	64.88
Pigeonpea + greengram			69.00	68.57	75.81	75.72	74.42	74.36	71.40	70.80
Weed management practices										
Herbicide	**Dose (g/ha)**	**Time of application**								
PMN	1000	PE	68.06	68.36	56.83	55.36	52.30	53.12	48.16	48.30
IMZ	100	PE	81.26	81.86	73.63	72.07	67.27	65.28	61.62	60.56
PXN	127.5	PE	76.31	74.72	71.27	69.48	65.64	63.17	62.46	60.51
PMN + IMZ (RM)	1000	PE	85.53	83.37	80.34	78.11	78.84	77.81	75.43	74.78
PMN *fb* one hoeing	1000	PE, 45 DAS	63.93	64.45	80.06	80.70	77.85	79.06	74.83	74.80
IMZ *fb* one hoeing	100	PE, 45 DAS	80.25	79.36	83.87	84.09	81.67	81.80	80.08	79.33
PXN *fb* one hoeing	127.5	PE, 45 DAS	75.12	77.30	82.98	83.72	80.35	79.38	77.98	77.29
PMN + IMZ (RM) *fb* one hoeing	1000	PE, 45 DAS	84.63	84.93	87.15	88.11	85.65	85.82	85.33	84.65
PMN *fb* IMZ	1000 & 100	PE, POE	69.29	70.07	77.69	76.95	75.11	75.58	73.57	73.67
IMZ	100	POE	35.17	36.57	67.87	66.19	58.72	61.05	56.73	57.02
Propaquiza fop + IMZ (TM)	125 (50+75)	POE	40.72	39.92	79.25	80.22	78.60	77.62	75.12	72.77
Two hoeings	-	25 & 45 DAS	94.30	92.00	92.56	93.29	86.54	87.20	85.46	86.11
Weed free	-	-	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Weedy check	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
General mean			68.18	68.07	73.82	73.45	70.61	70.49	68.34	67.84

Conclusion

Pigeonpea + greengram recorded higher crop equivalent yield and wce than sole pigeonpea. Two hoeings at 25 & 45 DAS or application of one pre-emergence herbicides followed by one hoeing at 45 DAS are better weed management option in pigeonoea + greengram intercropping systems.

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