The Bioscan 11(1): 583-588, 2016 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

INTEGRATED WEED MANAGEMENT IN PIGEONPEA (*CAJANUS CAJAN* L.) UNDER RAINFED CONDITIONS OF KARNATAKA

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KEYWORDS
Hand weeding
Imazethapyr
Pigeonpea
Weed dry weight
WCE
Yield

Received on :
13.09.2015

Accepted on :
17.02.2016

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ABSTRACT
A field investigation was carried out during rainy seasons of 2010, 2011 and 2012 at Agricultural Research Station, Gulbarga (Karnataka) to evaluate the effect of pre and post emergent herbicides on weeds and productivity of pigeonpea. The pooled data of three years indicated that, pre emergence application of pendimethalin @ 0.75 kg a.i ha^{-1} – one hand weeding at 50 DAS recorded significantly higher weed control efficiency (97.4%) similar to that of weed free plot (97.4%) and was on par with hand weeding twice at 25 and 50 DAS (94.2%) at 70 DAS. Application of imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS - paraquat @ 0.40 kg a.i. ha^{-1} at 6 weeks after sowing recorded significantly higher seed yield (1475 kg ha^{-1}), more number of pods per plant (165.7), pod weight (68.39 g $plant^{-1}$) and 100 seed weight (9.82 g) as compared to other treatments. Significantly lower seed yield (971 kg ha^{-1}) and yield parameters were recorded in weedy check treatment because of higher weed incidence and their competition throughout the growth period of pigeonpea.It can be concluded that, imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS - paraquat @ 0.40 kg a.i. ha^{-1} at 6 WAS can be effectively used for controlling weeds and in obtaining optimum seed yield of pigeonpea.

INTRODUCTION

Pigeonpea (*Cajanus cajan* L.) is the second important pulse crop of India only after chickpea. It is cultivated over an area of 3.90 m.ha with a total production of 2.89 m.t and productivity of 741 kg ha^{-1} (FAOSTAT, 2013). Pigeonpea is an important pulse crop of Karnataka state, having 5.80 lakh ha area, 2.60 lakh tones production and 448 kg ha^{-1} productivity. The low productivity of pigeonpea is due to an array of biotic and abiotic factors. One of the major constraints in pigeonpea production is weed infestation. Weeds compete with crop for light, moisture and nutrients, with early season competition being the most critical. In Karnataka, pigeonpea is mainly grown during rainy season. Due to its slow initial growth, wider spacing and continuous rains in monsoon season, severe infestation of weeds cause maximum damage to pigeonpea (Channappagoudar and Biradar, 2007). Unchecked weeds have been reported to cause a considerable yield reduction which in case of pigeonpea could be 32-65 percent (Vaishya and Khan, 1989, Kundra and Brar, 1990, Kandasamy, 1999, Guriqbal Singh and Sekhon, 2013). The critical period of crop weed competition is during the first eight weeks after sowing (Guriqbal Singh and Sekhon, 2013). Therefore it is imperative to control weeds at proper time with suitable methods to get high yield in pigeonpea. At present weeds are controlled by hand weeding twice at 25 and 45 days after sowing and hoeing. However, due to continuous rains during monsoon season it becomes difficult for manual weeding at right time. Furthermore, non availability of labour and increasing labour charges and being time consuming it was felt to find out suitable weed control methods involving herbicides. Pre emergent herbicides may helps in checking weed growth during this period. Pendimethalin, as pre emergence has been found very effective in controlling weeds and increasing yield (Reddy *et al.*, 2007 and Guriqbal Singh and Sekhon, 2013). The pre emergence herbicides are effective only for about intitial 30 days and thereafter weeds may threat pigeonpea crop. Therefore integrated use of pendimethalin with hand weeding or inter cultivation may help in effective control of weeds in pigeonpea. Sometimes due to unavoidable circumstances, it is not possible to spray pre emergent herbicides and later on it becomes very difficult to control the weeds manually. Under such circumstances, the best possible means to control new flush of weeds are through use of post emergence herbicides (Guriqbal Singh and Sekhon, 2013). Integrated weed management provides effective weed management in pigeonpea (Reddy *et al.* 2007, Sukhadia *et al.,* 2000 and Tomar *et al.,* 2004), groundnut (Basavaraj Kumbar *et al.,* 2014), greengram (Chhodavadia *et al.*, 2014) and blackgram (Rajib Das *et al.,* 2014). Therefore, the present investigation was undertaken with the objective to find out suitable integrated weed control measure in pigeonpea.

MATERIALS AND METHODS

Field experiment was conducted during *kharif* seasons of 2010, 2011 and 2012 at Agricultural Research Station,

Gulbarga, Karnataka, India. The soil (pH 8.80) of the experimental field was clay loam in texture, low in organic carbon (0.50%), available nitrogen (180 kg ha^{-1}), medium in available phosphorus (25 kg ha^{-1}) and high in available potassium (350 kg ha^{-1}). The experiment was laidout in randomized complete block design comprising ten treatment combinations viz., Weedy check (T_1), Hand weeding twice at 25 and 50 DAS (T_2), Pendimethalin @ 0.75 Kg a.i. ha^{-1} as pre-emergence (T_3), Pendimethalin @ 0.75 Kg a.i. ha^{-1} - one hand weeding at 50 DAS (T_4), Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS (T_5), Pendimethalin @ 0.75 Kg a.i. ha^{-1} - Post emergent spray of paraquat at 0.40 Kg a.i. ha^{-1} at 6 WAS (T_6), Imazethapyr @ 75 g a.i. ha^{-1} (20 DAS) + Paraquat at 0.40 Kg a.i. ha^{-1} at 6 WAS (T_7), Pendimethalin @ 0.75 Kg a.i. ha^{-1} - Post emergent spray of paraquat at 0.40 Kg a.i. ha^{-1} at 8 WAS (T_8), Imazethapyr @ 75 g a.i. ha^{-1} (20 DAS) - Paraquat at 0.40 Kg a.i. ha^{-1} at 8 WAS (T_9), Weed free check (T_{10}) with three replications. The pigeonpea variety ICP-8863 (160-175 days) was sown at 90 cm x 30 cm during first week of July and harvested during last week of December during all the three years of experimentation. The recommended fertilizer dose (25:50:0 kg/ha as N: P_2O_5 and K_2O) was applied at the time of sowing through urea and single super phosphate. The crop was raised under rainfed conditions with recommended package of practices for the zone. The pre-emergent herbicide i.e., pendimethalin was sprayed on the same day of sowing and post emergence herbicides *i. e.,* imazethapyr and paraquat were sprayed in between the crop rows (directed sprays) as per the treatments using 500 litres of water per hectare. The knapsack sprayer with flat fan nozzle and hood was used for spraying post emergence herbicides (paraquat).

Observations on weeds

Weed dry weight

The weed dry weight was recorded at 30, 50 and 70 DAS using an iron quadrate of 1 m^2 size. The weed samples were first dried under sun and then in hot air oven at 70° C for four days for recording the dry matter. The data was analyzed after subjecting the original data to square root transformation ("X + 1).

Weed control efficiency (WCE)

Weed control efficiency (WCE) was calculated by the following method as per the procedure given by Main et al. (2010).

$$WCE\ (\%) = \frac{\text{WCC - WCI}}{\text{WCC}} \text{ X } 100$$

Where,

WCC = Dry weight of weeds in unweeded control plot

WCT = Dry weight of weeds in treated plot

Weed control efficiency (WCE) was calculated at 30, 50 and 70 days after sowing.

Observations and analysis of data

Regarding agronomic characters, ten competitive plants were randomly selected from each plot and observations were recorded for growth and yield attributes. Whereas, seed yield obtained from the net plot area was recorded and expressed in kg ha^{-1}. The data were statistically analyzed as per the procedure given by Gomez and Gomez (2010) for randomized block design.

RESULTS AND DISCUSSION

Weed Flora

The season witnessed diversified weed flora in the experimental plot that could compete with crops for growth resources and bring reduction in the yield. The dominant weed flora found during all the three years of experimentation consisted of broad leaved weeds such as *Euphorbia hirta, Digera arvensis, Commelina benghalensis, Amaranthes viridis, Celosia argentia, Trianthema portulacastrum, phylanthus niruri, boerhavia diffusa, Cassia spp.,* grassy weeds such as *Cyperus rotundus, Cyanodan dactylon, Eleusine aegyptiacum* etc. Analysis of spectrum of weed flora revealed that broad leaved weeds are more problematic, constituting 80% and 20% by grassy weeds.

Weed dry matter

The results of the experiments showed that, dry matter of weeds in weedy check was maximum because of higher weed intensity and higher dry weight due to its dominance in utilizing the growth resources like sunlight, nutrients, moisture, CO_2 etc., Weed free check recorded significantly lower weed dry weight at all the stages of pigeonpea. These results are in close conformity with those reported by Dhonde *et al*.(2009), Sukhadia *et al.* (2000) *and Venkat Rao et al.* (2015). Among the herbicide treatments, pre emergence application of pendimethalin @ 0.75 kg a.i. ha^{-1} – post emergent spray of paraquat @ 0.40 kg a.i. ha^{-1} at 6 WAS was found significantly superior for controlling weeds in pigeonpea which recorded lowest weed dry weight at all the growth stages (4.2 g, 2.0 g and 1.5 g, respectively at 30, 50 and 70 DAS). The next best treatment which recorded lower weed dry weight were imazethapyr @ 75 g a.i. ha^{-1} (20 DAS) – paraquat @ 0.40 kg a.i. ha^{-1} at 8 WAS, pendimethalin @ 0.75 kg a.i. ha^{-1} – post emergent spray of paraquat @ 0.40 kg a.i. ha^{-1} at 8 WAS and imazethapyr @ 75 g a.i. ha^{-1} (20 DAS) – paraquat @ 0.40 kg a.i. ha^{-1} at 6 WAS. This might be due to the action of different pre and post emergent herbicides used in pigeonpea by their different mode of action on weeds i.e. primary mode of action of pendimethalin is to inhibit microtubule formation in cells of susceptible monocot and dicot weeds which are an important part of the cell division process. As a result of restricted cell division, growth of the emerging weed seedling is prevented. Post emergence application of imazethapyr is responsible for inhibition of acetolactate synthase (ALS) or acetohydroxyacid synthase (AHAS) in broad leaf weeds which caused destruction of these weeds at 3-4 leaf stage. Similar results have been reported by Guriqbal Singh and Sekhon (2007).

Weed control efficiency (WCE)

Significantly lower weed control efficiency was recorded in weedy check and maximum in weed free check (99.4, 100 and 97.4% respectively at 30, 50 and 70 DAS). Among the weed control treatments, application of pendimethalin @ 0.75 kg a.i. ha^{-1} – post emergent spray of paraquat @ 0.40 kg a.i. ha^{-1} at 6 WAS recorded highest weed control efficiency (97.4%) at 70 DAS, followed by imazethapyr @ 75 g a.i. ha^{-1} (20 DAS) – paraquat @ 0.40 kg a.i. ha^{-1} at 8 WAS (84.9%), pendimethalin @ 0.75 kg a.i. ha^{-1} – post emergent spray of paraquat @ 0.40

Table 1: Growth parameters of Pigeonpea as influenced by Integrated Weed Management (IWM) practices

Sl.No.	Treatments	Plant height (cm)				Number of primary branches plant^{-1}				Total dry matter g plant^{-1}at harvest			
		2010	2011	2012	Pooled	2010	2011	2012	Pooled	2010	2011	2012	
Pooled													
1	Weedy check	136	124	140	133	7.5	6.8	8.1	7.5	118.8	122.6	129.1	123.5
2	Hand weeding twice at 25 and 50 DAS	176	162	182	173	10.8	10.1	10.2	10.4	147.2	149.9	155.7	150.9
3	Pendimethalin @ 0.75 Kg a.i.ha^{-1} as pre-emergence	152	139	156	149	8.1	9.2	8.8	8.7	129.7	132.5	140.4	134.2
4	Pendimethalin @ 0.75 Kg a.i.ha^{-1} - one hand weeding at 50 DAS	189	174	195	186	11.6	10.9	11.1	11.2	161.5	162.2	165.4	163.0
5	Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS	169	155	174	166	9.3	9.8	9.2	9.4	135.1	139.1	145.2	139.8
6	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i ha^{-1} at 6 WAS	178	164	184	175	11.1	10.5	10.4	10.7	157.9	159.9	161.6	159.8
7	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i.ha^{-1} at 6 WAS	206	189	212	202	12.8	12.1	14.2	13.0	178.4	180.2	182.9	180.5
8	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i.ha^{-1} at 8 WAS	173	159	178	170	10.2	10	9.8	10.0	139.7	145.8	150.7	145.4
9	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i. ha^{-1} at 8 WAS	202	185	208	199	12.3	11.8	13.6	12.6	163.9	166.4	170.2	166.8
10	Weed free plot	208	191	215	205	14.5	12.9	16.8	14.7	195.7	198.8	210.7	201.7
	S.Em.±	8	7	7	6.5	0.40	0.38	0.43	0.35	8.1	8.7	7.7	8.0
	CD at 5%	23	22	20	19.0	1.19	1.14	1.27	1.08	24.2	26.1	22.9	23.8

Table 2: Yield parameters of Pigeonpea as influenced by Integrated Weed Management (IWM) practices

Sl.No.	Treatments	No. of pods plant^{-1}				Pod weight g plant^{-1}				100 seed weight (g)			
		2010	2011	2012	Pooled	2010	2011	2012	Pooled	2010	2011	2012	Pooled
1	Weedy check	68.5	72.9	80.4	73.9	27.88	30.91	32.75	30.51	8.11	8.53	8.24	8.29
2	Hand weeding twice at 25 and 50 DAS	138.9	144.8	154.8	146.2	56.54	61.39	63.06	60.33	9.43	9.33	9.31	9.36
3	Pendimethalin @ 0.75 Kg a.i.ha^{-1} as pre-emergence	125.8	129.6	138.4	131.3	51.21	54.94	56.38	54.18	9.08	9.11	9.11	9.10
4	Pendimethalin @ 0.75 Kg a.i.ha^{-1} - one hand weeding at 50 DAS	147.2	151.8	165.4	154.8	59.92	64.35	67.38	63.88	9.67	9.58	9.48	9.58
5	Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS	129.1	131.2	145.2	135.2	52.55	55.62	59.15	55.77	9.22	9.18	9.18	9.19
6	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i ha^{-1} at 6 WAS	144.1	147.1	160.3	150.5	58.65	62.36	65.30	62.11	9.55	9.44	9.37	9.45
7	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i.ha^{-1} at 6 WAS	157.2	161.8	178.2	165.7	63.99	68.59	72.59	68.39	9.81	9.77	9.89	9.82
8	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i.ha^{-1} at 8 WAS	133.4	139.4	149.5	140.8	54.30	59.10	60.90	58.10	9.30	9.21	9.22	9.24
9	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i. ha^{-1} at 8 WAS	152.4	157.4	172.8	160.9	62.03	66.73	70.39	66.38	9.72	9.75	9.53	9.67
10	Weed free plot	168.8	175.2	187.5	177.2	68.71	74.28	76.38	73.12	9.97	9.84	10.18	10.00
	S.Em±	6.7	6.9	7.5	6.5	2.7	3.2	3.6	2.8	0.18	0.22	0.21	0.19
	CD at 5%	19.9	20.5	22.3	18.4	8.0	10.1	11.2	8.5	0.55	0.63	0.62	0.56

Table 3: Seed yield (kg ha^{-1}) as influenced by IWM in pigeonpea (pooled)

Sl.No.	Treatments	Seed yield (kg ha^{-1}) 2010	2011	2012	Pooled
1	Weedy check	1080	745	1088	971
2	Hand weeding twice at 25 and 50 DAS	1405	969	1416	1263
3	Pendimethalin @ 0.75 Kg a.i.ha^{-1} as pre-emergence	1209	834	1219	1087
4	Pendimethalin @ 0.75 Kg a.i.ha^{-1} - one hand weeding at 50 DAS	1510	1041	1522	1358
5	Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS	1345	928	1356	1210
6	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i ha^{-1} at 6 WAS	1420	979	1431	1277
7	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i.ha^{-1} at 6 WAS	1640	1131	1654	1475
8	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i.ha^{-1} at 8 WAS	1380	952	1392	1241
9	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i. ha^{-1} at 8 WAS	1610	1110	1622	1447
10	Weed free plot	1660	1145	1673	1493
	S.Em. ±	90	62	69	61
	C.D.at 5%	268	185	205	181

Table 4: Effect of different weed management practices on Weed dry weight (g plant^{-1}) in pigeonpea

Sl.No.	Treatments	Weed dry weight (g plant^{-1}) 2010			2011			2012			Pooled		
		30 DAS	50 DAS	70 DAS	30 DAS	50 DAS	70 DAS	30 DAS	50 DAS	70 DAS	30 DAS	50 DAS	70 DAS
1	Weedy check	41.2 (39.9)	84.3 (66.7)	99.2 (84.9)	44.0 (41.6)	22.1 (28.0)	21.4 (27.6)	41.3 (40.0)	55.1 (47.9)	65.4 (54.0)	42.2 (40.5)	53.8 (47.2)	69.7 (51.9)
2	Hand weeding twice at 25 and 50 DAS	1.6 (7.3)	0.2 (2.6)	2.9 (9.8)	0.8 (5.1)	0.6 (4.4)	1.9 (7.9)	1.8 (7.7)	1.2 (6.3)	3.7 (11.1)	1.4 (6.8)	0.7 (4.7)	2.8 (9.7)
3	Pendimethalin @ 0.75 Kg a.i.ha^{-1} as pre-emergence	21.2 (27.4)	29.7 (33.0)	41.5 (40.1)	36.3 (37.0)	17.2 (24.5)	16.3 (23.8)	26.2 (30.8)	21.5 (27.6)	30.1 (33.3)	27.9 (31.9)	22.8 (28.5)	29.3 (32.8)
4	Pendimethalin @ 0.75 Kg a.i.ha^{-1} - one hand weeding at 50 DAS	16.8 (24.2)	0.0 (0.0)	6.2 (14.4)	27.0 (31.3)	0.0 (0.00)	18.0 (25.1)	19.8 (26.4)	1.0 (5.7)	14.2 (22.1)	21.2 (27.4)	0.3 (3.3)	12.8 (21.0)
5	Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS	22.5 (28.3)	18.9 (25.8)	12.5 (20.7)	30.2 (33.3)	13.3 (21.4)	7.1 (15.5)	23.7 (29.1)	15.8 (23.4)	10.4 (18.8)	25.5 (30.3)	16.0 (23.6)	10.0 (18.4)
6	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i ha^{-1} at 6 WAS	4.5 (12.2)	2.6 (9.3)	1.7 (7.5)	3.3 (10.5)	1.1 (6.0)	0.6 (4.4)	4.7 (12.5)	2.3 (8.7)	2.2 (8.5)	4.2 (11.8)	2.0 (8.1)	1.5 (7.0)
7	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0. 40 Kg a.i.ha^{-1} at 6 WAS	13.5 (21.6)	17.3 (24.6)	7.2 (15.6)	36.2 (37.0)	16.7 (24.1)	10.0 (18.4)	23.8 (29.2)	16.7 (24.1)	9.4 (17.9)	24.5 (29.7)	16.9 (24.3)	8.9 (17.3)
8	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i.ha^{-1} at 8 WAS	19.3 (26.1)	3.9 (11.4)	8.5 (17.0)	22.0 (28.0)	10.0 (18.4)	5.5 (13.6)	22.9 (28.6)	8.1 (16.5)	8.4 (16.8)	21.4 (27.6)	7.3 (15.7)	7.5 (15.9)
9	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i. ha^{-1} at 8 WAS	11.8 (20.1)	7.5 (15.9)	5.8 (13.9)	27.3 (31.5)	10.8 (19.2)	6.1 (14.3)	17.6 (24.8)	10.1 (18.5)	7.1 (15.5)	18.9 (25.8)	9.5 (17.9)	6.3 (14.6)
10	Weed free plot	0.0 (0.0)	0.0 (0.00)	1.2 (5.3)	0.0 (0.0)	0.0 (0.00)	0.8 (5.1)	0.8 (5.1)	0.0 (0.00)	1.8 (7.7)	0.3 (3.0)	0.0 (0.0)	1.3 (6.5)
	S.Em ±	1.8	1.9	2.1	2.3	1.4	1.3	1.9	1.8	2.0	1.8	1.5	1.7
	CD at 5%	5.4	5.8	6.3	7.0	4.3	4.0	5.6	5.4	5.8	5.4	4.3	5.0

* Figures in the parenthesis are transformed values

Table 5: Effect of different weed management practices on weed control efficiency (WCE) in pigeon pea.

Sl.No.	Treatments	Weed Control Efficiency (%) 2010 30 DAS	2010 50 DAS	2010 70 DAS	2011 30 DAS	2011 50 DAS	2011 70 DAS	2012 30 DAS	2012 50 DAS	2012 70 DAS	Pooled 30 DAS	Pooled 50 DAS	Pooled 70 DAS
1	Weedy check	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Hand weeding twice at 25 and 50 DAS	96.1	99.8	97.1	98.2	97.3	91.1	95.6	97.8	94.3	96.6	98.3	94.2
3	Pendimethalin @0.75 Kg a.i.ha^{-1} as pre-emergence	48.5	64.8	58.2	17.5	22.2	23.8	36.6	61.0	54.0	34.2	49.3	45.3
4	Pendimethalin @ 0.75 Kg a.i.ha^{-1} - one hand weeding at 50 DAS	59.2	100.0	93.8	38.6	100.0	15.9	52.1	98.2	78.3	50.0	99.4	62.6
5	Imazethapyr @ 75 g a.i. ha^{-1} at 20 DAS	45.4	77.6	87.4	31.4	39.8	66.8	42.6	71.3	84.1	39.8	62.9	79.4
6	Pendimethalin @ 0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i ha^{-1} at 6 WAS	89.1	96.9	98.3	92.5	95.0	97.2	88.6	95.8	96.6	90.1	95.9	97.4
7	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i.ha^{-1} at 6 WAS	67.2	79.5	92.7	17.7	24.4	53.3	42.4	69.7	85.6	42.4	57.9	77.2
8	Pendimethalin @0.75 Kg a.i./ha - Post emergent spray of paraquat at 0.40 Kg a.i.ha^{-1} at 8 WAS	53.2	95.4	91.4	50.0	54.8	74.3	44.6	85.3	87.2	49.2	78.5	84.3
9	Imazethapyr @ 75 g a.i./ha (20 DAS) - Paraquat at 0.40 Kg a.i. ha^{-1} at 8 WAS	71.4	91.1	94.2	38.0	51.1	71.5	57.4	81.7	89.1	55.6	74.6	84.9
10	Weed free plot	100.0	100.0	98.8	100.0	100.0	96.3	98.1	100.0	97.2	99.4	100.0	97.4
	S.Em±	3.2	4.7	4.2	2.7	2.1	2.7	3.2	3.7	3.6	3.1	3.3	3.8
	CD at 5%	9.7	14.0	12.6	8.1	6.4	8.0	9.7	10.8	10.8	9.3	9.7	11.4

kg a.i. ha^{-1} at 8 WAS (84.3%) and imazethapyr @ 75 g a.i ha^{-1} at 20 DAS (79.4%). These results are also in conformity with the findings of Rajput and Pandey (1994) and Sharma *et al.* (2014).

Effect of weeds on growth, yield and yield attributing characters of pigeonpea

Different weed control treatments were found to be significantly affected various growth and yield attributing characters in pigeonpea over control treatment. Taller plants, more number of branches, highest plant dry matter, more number of pods per plant, higher pod weight and test weight were observed in weed free check. Among the herbicide treatments, imazethapyr @ 75 g a.i ha^{-1} (20 DAS) - paraquat at 0.40 Kg a.i ha^{-1} at 6 WAS recorded higher growth and yield attributes as compared to rest of the weed management practices. This might be due to effect of different herbicides that controlled the weeds and reduced the competition of crop with weeds for growth resources like space, air, sunlight, moisture and nutrients.

Progressive and significantly higher number of pods per plant, pod weight per plant, test weight and grain yield of pigeonpea were obtained with different weed control measures over weedy check. The weed free treatment recorded the highest number of pods per plant (177.2), test weight (10.0 g) and grain yield (1493 kg ha^{-1}) than weedy check (73.9, 8.29 g and 971 kg ha^{-1}, respectively). The lower grain yield and yield parameters in weedy check was mainly due to emergence of weeds since beginning of crop that resulted in intense competition with crop plants for nutrients, moisture and sunlight. However, among the set of IWM treatments, the maximum grain yield was recorded under IWM treatments viz., imazethapyr @ 75 g a.i ha^{-1} (20 DAS) – paraquat @ 0.40 kg a.i ha^{-1} at 6 WAS (1475 kg ha^{-1}), imazethapyr @ 75 g a.i ha^{-1} (20 DAS) – paraquat @ 0.40 kg a.i ha^{-1} at 8 WAS (1447 kg ha^{-1}) and pendimethalin @ 0.75 kg a.i ha^{-1} – one hand weeding at 50 DAS (1358 kg ha^{-1}) and differences between these three treatment combinations were statistically at par with each other as well as with weed free plot. Higher grain yields in these treatments may be due to effective weed control as reflected in lower weed dry weight, higher weed control efficiency, better plant growth and yield attributes. These findings are in concurrence with those of Dhonde *et al.* (2009) and Venkat Rao *et al.* (2015).

REFERENCES

Basavaraj Kumbar, Ramachandra Prasad, T. V. Sanjay, M. T. Mallikarjuna, G. B. Veeresh Hatti and Madhukumar 2014. Influence of weed management practices on crop growth, nutrient uptake and yield of ground nut under irrigated conditions. *The Bioscan*. **9:** 1843-1846.

Channappagoudar, B. B. and Biradar, N. R. 2007. Physiological approaches for weed management in soybean and redgram (4:2) intercropping system. *Karnataka J. Agric. Sci.* **20:** 241-244.

Chhodavadia, S. K. Sagarka, B. K and Gohil, B. S. 2014. Integrated management for improved weed suppression in summer green gram (*Vigna radiata* L. Wilczek). *The Bioscan*. **9:** 1577-1580.

Dhonde, M. B., Kate, S. R., Pandure, B. S. and Tambe, A. D. 2009. Integrated weed management in pigeonpea. *Ind. J. Weed. Sci.* **41:** 102-105.

FAOSTAT 2013. http://faostat.fao.org.

Gomez, K. A. and Gomez, A. A. 2010. Statistical procedures for agriculture research. *Wiley Indian Pvt. Ltd.*, New Delhi, India.

Guriqbal Singh and Sekhon, H. S. 2013. Integrated Weed Management in Pigeonpea (*Cajanus cajan* (L.) Millsp.). *World J. Agric. Sci.* **9:** 86-91.

Kandasamy, O. S. 1999. Effect of herbicide with and without manual weeding on weed and yield of rainfed pigeonpea (*Cajanus cajan*). *Leg. Res.* **22:** 172-176.

Kundra, H. C. and Brar, L. S. 1990. Integrated weed management in pigeon pea (*cajanus cajan*). Paper Presented in Biennial conference of *Indian society of Weed Science*, Jabalapur. p. 83.

Main, C. L., Michael, A. S. and Murdock, E. C. 2010. Weed response and tolerance of enhanced glyphosate resistant cotton to glyphosate. *J. Cotton Sci.* **11:** 104-109.

Rajib Das, Patra, B. C. Mandal, K. and Animesh Pathak 2014. Integrated weed management in Blackgram (*Vigna mungo*, L) and its effect on soil microflora under sandy loam soil of West Bengal. *The Bioscan*. **9:** 1593-1596.

Rajput, A. L. and Pandey, B. P. 1994. Chemical weed control in pigeonpea. *Ind. J. Agron.* **39:** 27-30.

Reddy, M. M., Vilatha, A. M. and Rao, L. J. 2007. Integrated weed management in pigeonpea (*Cajanus cajan*) - Soybean (*Glycine max*) intercropping system on Vertisol under rainfed conditions. *Indian J. Agric. Sci.* **77:** 177-178.

Sharma, J. C., Chandra Prakash, Shivran, R. K. and Narolia, R. S. 2014. Integrated weed management in pigeonpea (*Cajanus cajan* (L.) Millsp.). *Academic Res. J.* **2:** 69-74.

Sukhadia, N. M., Ramani, B. B., Modhwadia, M. M. and Asodaria, K. B. 2000. Integrated weed management in pigeonpea (*Cajanus cajan* L. Millsp.). *Gujarat Agric. Univ. Res. J.* **25:** 1-4.

Tomar, J., Singh, H. B. Vivek and Tripathi, S. S. 2004. Integrated weed management in intercropping of mungbean (*Vigna radiata*) and cowpea fodder (*Vigna unguiculata*) with pigeonpea (*Cajanus cajan*) under western U. P. condition. *Indian J. Weed Sci.* **36:** 133-134.

Vaishya, R. D. and Khan, Ali 1989. Weed management with herbicides in pigeonpea. *International Pigeon pea News Letter*. **9:** 14-16.

Venkat Rao, P., Subbarami Reddy, A. and Koteshwara Rao, Y. 2015. Effect of integrated weed management practices on growth and yield of pigeonpea (*Cajanus cajan* (L.) Millsp.). *Int. J. plant, animal and Environmental Sciences*. **5:** 124-127.