Indian Journal of Weed Science (2023) **55**(1): 107–110
http://dx.doi.org/10.5958/0974-8164.2023.00019.9

RESEARCH NOTE

Crop establishment methods and weed management on productivity of cowpea

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Received: 26 January 2022 | Revised: 1 December 2022 | Accepted: 3 December 2022

ABSTRACT

A field study was carried out at College of Agriculture, Vellanikkara during October- December 2020 to study the effect of different crop establishment and weed management methods on the productivity of cowpea. Treatment consisted of two crop establishment methods, *viz.* broadcast seeding and line sowing and six weed management treatments, *viz.* hand weeding twice 20 and 40 days after seeding (DAS), post-emergence application (PoE) of imazethapyr + imazamox (pre-mix) 40 g/ha at 15-20 DAS, imazethapyr + imazamox 40 g/ha (pre-mix) PoE at 15- 20 DAS followed by (*fb*) hand weeding at 40 DAS, imazethapyr 40 g/ha PoE at 15- 20 DAS, imazethapyr, 40 g/ha PoE at 15- 20 DAS *fb* hand weeding 40 DAS and unweeded control. The highest cowpea yield was recorded with hand weeding twice (937.67 kg/ha), followed by imazethapyr + imazamox 40 g/ha PoE at15- 20 DAS *fb* hand weeding (877.30 kg/ha). Line sown crop recorded higher cowpea yield compared with broadcasting. Imazethapyr + imazamox 40 g/ha PoE at 15- 20 DAS *fb* hand weeding at 40 DAS use in broadcasted seeded and line sown cowpea resulted in higher grain yield, net return and B:C and hence can be recommended as a cost effective weed management practice for enhancing productivity of broadcasted seeded and line sown cowpea.

Keywords: Cowpea, Establishment method, Imazamox + imazethapyr, Line sowing, Weed management

Cowpea (*Vigna unguiculata*) is a warm weather leguminous crop, grown in both tropical and subtropical climate. Better performance under harsh and hardy condition, tolerance to heavy rain, smothering character, and soil restoring properties facilitate year round production of cowpea, which grown as sole crop, intercrop, catch crop, cover crop, green manure crop for the purpose of green pods, grains and fodder. Cowpea grain contains 24-32% protein, 50-60% carbohydrate and 1% fat. Protein is 2-3 times of cereal and tubers and rich in lysine and tryptophan, which makes an excellent complimentary food with rice and wheat**.**

Broadcast seeding is the commonly adopted method of planting for cowpea. Line sowing is another method of crop establishment suitable for cowpea. Weed infestation declines the yield, intensifies pest and disease problem, increases the cost of production and reduces the quality of produce. The uncontrolled weeds cause cowpea yield reduction up to 70.8% (Mekonnen *et al.* 2015). Cowpea is considered as a smother crop, due to thick and quick foliage growth but weedy conditions during the initial phase of growth adversely affect the crop. Hence, proper weed management during critical period optimises the overall growth and yield of cowpea.

Manual weeding is time consuming, laborious and uneconomical in large scale cultivation. Use of herbicides appears to be an alternate option, which is easy, economical, rapid in action, effective and safe, if used properly. The research on the economical an effective herbicide for weed management in broadcasted seeded and line sown cowpea is limited. Hence the present study was carried out to identify effective and economical weed management options for enhancing productivity of cowpea established by broadcasting seeding and line sowing.

Field experiment was carried out from October to December 2020 at the Department of Agronomy, College of Agriculture, Vellanikkara. The experiment was laid out with factorial RBD with two factors replicated thrice. Tested treatments include: two methods of crop establishments, *viz.* broadcast seeding and line sowing and six weed management treatments, viz., hand weeding twice at 20 and 40 days after seeding (DAS), post-emergence application (PoE) of imazethapyr + imazamox (pre-mix) 40 g/ha at 15-20 DAS , imazethapyr + imazamox 40 g/ha PoE at 15- 20 DAS followed by (*fb*) hand weeding at 40 DAS, imazethapyr 40 g/ha PoE at 15-20 DAS, imazethapyr 40 g/ha PoE at 15- 20 DAS *fb*

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hand weeding at 40 DAS and unweeded control. Cowpea variety PGCP-6 was used.

The soil of the experimental site was sandy clay loam in texture with a pH of 4.03, low in nitrogen, rich in phosphorous and medium in potassium. Beds of size 3.6 x 3.6 m were prepared for each treatment. Lime was applied at 250 kg/ha and before planting FYM (20 t/ha) was applied. Urea, factomphos and muriate of potash were applied to supply 20:30:30 kg N, P and K per hectare. Broadcast seeding and line sowing were done using seed rate of the rate of 25 kg/ha and 40 kg/ha in respective plots. Line sowing was done at a spacing of 30 cm x 15 cm. Five plants were selected at random for recording observations. The observations on weed density and biomass were taken at 30 and 60 DAS. Weeds samples were collected by using a quadrat of 50 cm x 50 cm. Data was analysed statistically by using GRAPES (General R shiny based Analysis Platform Empowered by Statistics).

Weed flora

Weed flora of experimental site comprised of broad-leaved weeds, grasses and sedges. Among broad-leaved weeds: *Phyllanthus amara, Mimosa pudica, Mitracarpus hirtus, Euphorbia hirta, Scoparia dulcis, Ageratum conyzoides, Cleome burmannii* and *Mollugo* sp. were dominant. *Digitaria ciliaris, Echinochloa colona, Cynodon dactylon* and *Oryza sativa* were major grassy weeds. *Cyperus iria* was the only sedge observed in field.

Effect on weeds

Line sowing of cowpea resulted in less weed density compared to broadcast seeding. The lowest weed biomass (3.50 and 4.66/gm^2), weed index (22%) and higher weed control efficiency (75% and 70%) was noted from line sown plots compared with broadcast seeded plot having higher weed biomass (5.09 and 4.91/gm^2), lower weed control efficiency (64% and 68%) and higher weed index (24%) as observed by Singh (2011). Higher weed biomass and reduced yield in broadcast seeding method might be a reason for low weed control efficiency and high weed index. In line sowing method, seeds were sown at a particular spacing, the growth of foliage led to faster canopy closer due to narrow spacing that hindered penetration of light causing reduction in germination and growth of weed seedling resulting in reduced weed density and biomass. Ashrafi *et al.* (2009) observed that line sowing is superior to broadcast seeding method of cowpea establishment, for effective weed management.

The broad-leaved weeds and grasses density and biomass; higher weed control efficiency was significantly influenced by weed management practices at both stages of observation. At 30 and 60 DAS, lower weed density and biomass was observed in hand weeded treatment closely followed by imazethapyr PoE *fb* HW at 40 DAS **(Table 1)**. This might be due to the continuous weed control in these treatments due to the hand weeding done at 40 DAS. The efficacy of imazethapyr and imazethapyr + imazamox in lowering weed density and biomass was reported by Rana *et al.* (2019) and Kumar and Singh (201)7.

At 30 DAS, the highest weed control efficiency was noted with hand weeding twice 20 and 40 DAS (90.34 %) followed by imazethapyr + imazamox 40 g/ha PoE 15- 20 DAS *fb* hand weeding 40 DAS (84.7%), which was on par with imazethapyr 40 g/ha PoE 15- 20 DAS (81.73%). Higher weed biomass and reduced yield might be a reason for low weed control efficiency and high weed index in unweeded plot. At 60 DAS also, hand weeding twice recorded higher weed control efficiency (87.38%). Deshkari *et al.* (2019) also reported similar findings. Imazethapyr + imazamox, 40 g/ha PoE 15- 20 DAS + hand weeding at 40 DAS recorded lower weed index.

Imazethapyr + imazamox, 40 g/ha PoE 15-20 DAS *fb* HW 40 DAS recorded lower weed biomass, weed index and higher weed control efficiency compared with imazethapyr + imazamox 40 g/ha PoE 15- 20 DAS. This can be attributed to the higher efficiency of integrated use of herbicides with physical control method such as hand weeding (Lamichhane *et al.* 2017).

Effect on cowpea growth and yield

Significantly higher yield was obtained with line sown cowpea (717 kg/ha) compared with broadcast seeded cowpea. Enough space will be available for line sown crops for the better orientation of leaves, which helps to harvest more light resulted in high photosynthetic rate and accumulation of photosynthates which eventually resulted in high grain yield of cowpea as observed by Mohler *et al.* (2001). Imazethapyr + imazamox 40 g/ha PoE 15- 20 DAS *fb* hand weeding at 40 DAS resulted in taller cowpea plants with higher LAI and dry matter production. Imazethapyr + imazamox 40 g/ha PoE 15-20 DAS *fb* hand weeding registered significantly higher number of pods per plant, pod weight, number of seeds per pod and 100 grain weight. The highest yield was recorded with hand weeding twice (938 kg/ha), followed by imazethapyr + imazamox 40 g/ha

PoE 15- 20 DAS *fb* hand weeding (877 kg/ha) **(Table 2)**. Similar result was also reported by Sasode *et al.* (2020) in blackgram. Adoption of weed management practices resulted in 70% higher yield in cowpea. Efficient weed control by herbicides, hand weeding and herbicides coupled with hand weeding at critical period of crop weed competition reduced competition of weeds with cowpea for resources, resulted in proper absorption of nutrients by crop and higher growth and yield parameters.

Economics

Broadcast seeding recorded higher net returns (₹ 82683/ha) and B:C (2.35) compared with line sowing, which recorded net returns of ₹ 71672/ha and B:C of 1.91. It was due to lower cost of cultivation for broadcast seeded cowpea. Labourers required for dibbling of seeds are more in line sown cowpea which resulted in higher cost of cultivation. Line sown cowpea registered the highest production and gross returns, but owing to high labour cost it recorded lower value of B:C compared to broadcast seeding. Saha *et al.* (2021) also reported that cost of cultivation for manual line sowing was very high compared to drill and broadcast seeding.

The highest net returns (₹ 102861/ha) and B:C (2.45) were noted with imazethapyr + imazamox, 40 g/ha PoE 15- 20 DAS *fb* HW at 40 DAS in broadcast seeded cowpea **(Table 3).** Weed management treatments have reduced weed density and biomass which reduced crop weed competition, helped the crop to grow with maximum potential and increased absorption of nutrients finally resulted in good yield contributing characters and yield. High grain yield resulted in maximum income. Higher net income from treated plot than weedy check might be an evidence for the efficiency of adopted weed control measures as observed by Mansoori *et al.* (2015) and Yadav *et al.* (2015).

Table 1. Effect of crop establishment and weed management treatments on weeds and cowpea growth parameters

Treatment	Total weed density (no./ m^2)		Weed biomass (g/m^2)		Weed control efficiency (WCE) (%)		Weed index (WI)	Leaf area index (LAI)		Dry matter production (DMP) at harvest (kg/ha)
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS		40 DAS	60 DAS	
Crop establishment method										
Broadcast seeding	3.65(14.2)	2.61(6.7)	2.23(5.1)	2.16(4.9)	64.41	68.61	24.63	6.09	7.74	4501.51
Line sowing	2.74(8.7)	2.65(6.9)	1.86(3.5)	2.12(4.7)	75.49	70.21	22.04	3.55	4.50	4377.81
LSD (p=0.05)	0.09	NS	0.10	0.02				0.18	0.16	NS
Weed management practice										
Hand weeding twice at 20 and 40 DAS	2.48(5.8)	1.95(3.3)	1.34(1.3)	1.58(2.0)	90.34	87.38	1.47	4.76	5.90	4276.71
Imazethapyr + imazamox 40 g/ha PoE 15-20 DAS	2.64(6.7)	2.61(6.3)	1.97(3.5)	2.26(4.6)	75.76	70.55	24.83	4.81	6.21	4488.63
Imazethapyr + imazamox 40g/ha PoE 15-20 DAS *fb* HW 40 DAS	2.63(6.6)	1.95(3.3)	1.63(2.2)	1.88(3.0)	84.70	80.61	7.81	4.86	6.28	4762.75
Imazethapyr 40 g/ha PoE 15- 20 DAS	2.92(8.7)	2.70(6.8)	1.75(2.6)	1.59(2.0)	81.73	87.02	23.97	5.04	6.33	4625.69
Imazethapyr 40 g/ha PoE 15- 20 DAS *fb* HW 40 DAS	2.64(6.6)	2.88(7.5)	1.90(3.2)	1.59(2.0)	77.50	87.07	11.56	5.13	6.20	5084.68
Un weeded control	5.86(34.0)	3.76(13.7)	3.66(13.0)	3.94(15.1)	9.66	38.73	70.38	4.34	5.77	3399.50
LSD (p=0.05)	0.23	0.14	0.17	0.02				0.32	0.28	708.24

PoE: post-emergence application; HW: Hand weeding; DAS: days after seeding

Table 2. Effect of crop establishment and weed management treatments on yield parameters of cowpea

Treatment	Days to 50% flowering	100 grain weight (g)	No. of pods per plant	No. of seeds per pod	Pod weight (g)	Yield (kg/ha)
Crop establishment method						
Broadcast seeding	33.17	10.91	37.61	15.12	1.26	717
Line sowing	31.67	10.93	37.83	14.16	1.31	742
SE (m)	0.12			0.14	0.01	1.8
LSD (p=0.05)	0.37	NS	NS	0.42	0.04	5.2
Weed management practice						
Hand weeding twice at 20 and 40 DAS	32.17	11.08	41.66	15.00	1.49	938
Imazethapyr + imazamox 40 g/ha PoE 15-20 DAS	32.67	10.45	36.00	14.48	1.18	715
Imazethapyr + imazamox 40g/ha PoE 15-20 DAS *fb* HW 40 DAS	32.17	10.65	42.16	14.17	1.53	877
Imazethapyr 40 g/ha PoE 15- 20 DAS	32.67	11.50	35.67	13.80	1.24	723
Imazethapyr 40 g/ha PoE 15- 20 DAS *fb* HW 40 DAS	32.50	11.57	39.33	16.48	1.16	842
Un weeded control	32.33	10.26	31.50	13.90	1.11	282
LSD (p=0.05)	NS	0.54	1.41	0.74	0.06	9.1

PoE: post-emergence application; HW: Hand weeding; DAS: days after seeding

Table 3. Effect of crop establishment methods and weed management treatments on cost of cultivation, gross return, net return and B:C ratio

Treatment	Cost of cultivation (x10^3 `/ha)	Gross returns (x10^3 `/ha)	Net returns (x10^3 `/ha)	B:C
Crop establishment method				
Broadcast seeding	60.76	143.44	82.68	2.35
Line sowing	76.73	148.40	71.67	1.91
Weed management practice				
Hand weeding twice at 20 and 40 DAS	103.36	187.53	84.17	1.83
Imazethapyr + imazamox 40 g/ha PoE 15-20 DAS	65.63	143.07	77.44	2.22
Imazethapyr + imazamox 40g/ha PoE 15-20 DAS *fb* HW 40 DAS	72.60	175.47	102.86	2.45
Imazethapyr 40 g/ha PoE 15- 20 DAS	64.01	144.70	80.69	2.30
Imazethapyr 40 g/ha PoE 15- 20 DAS *fb* HW 40 DAS	71.03	168.33	97.30	2.40
Un weeded control	35.83	56.43	20.60	1.59

PoE: post-emergence application; HW: Hand weeding; DAS: days after seeding

This study indicated that though line sowing resulted in increased productivity, the higher net returns and B:C was obtained with broadcast seeding. Weed management practices increased the productivity of cowpea under both crop establishment methods. Application of imazethapyr + imazamox, 40 g/ha PoE 15-20 DAS *fb* hand weeding at 40 DAS can be recommended as a cost-effective weed management practice for enhancing productivity of broadcast seeded and line sown cowpea.

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