

Weed-free period requirement of drill-sown onion (*Allium cepa*) – chilli (*Capsicum annuum*) – cotton (*Gossypium herbaceum*) relay intercropping system in rainfed Vertisols

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ABSTRACT

A field experiment was conducted at Water Management Research Centre, Belvatagi for 2 years to find out the effect of different crop weed competition periods on drilled onion (*Allium cepa* L.), chilli (*Capsicum annuum* L.) and cotton (*Gossypium herbaceum* L.) relay intercropping under direct-seeded conditions. The weed flora was dominated with broad-leaved weeds (66%), followed by grasses (33%) and sedges (1%). The growth, yield parameters and yield of onion, chilli and cotton increased when the plots were maintained weed free condition up to 40 days in onion, up to 60 days weed-free in chilli and up to 120 days weed-free for the whole onion, chilli and cotton relay intercropping. Initial weed-free periods up to 20 or 40 days did not influence the seed cotton yields. Quality parameters of onion, chilli and cotton were not influenced by the weed-free periods.

Key words: Chilli, Cotton, Drilled onion, Weed-free period

Onion (*Allium cepa* L.), chilli (*Capsicum annuum* L.) and cotton (*Gossypium herbaceum* L.) are the most extensively grown commercial crops in rainfed Vertisols of northern Karnataka under intercropping systems. This system is the most assured and paying intercropping system since least competition exists among the component crops, especially when cotton variety 'Jayadhar' was used (Kumaraswamy *et al.* 1978) and still continues to be the important cropping system (Hosmani 1993). Among these 3 crops, onion is the poor competitor to weeds due to its short stature, non-branching habit, sparse foliage, shallow root system and extremely slow growth in the initial stages, enabling quick and rapid growth of weeds.

Losses due to weeds in cotton vary from 10 to 90% (Halemani *et al.* 2004). The yield reduction in onion due to uncontrolled weeds was as high as 78 % in drilled and 53 % under transplanted condition and sole-drilled onion requires weed-free period of 45 days (Kalyanamurthy 2002), for chilli 60 days (Frank *et al.* 1988) and for cotton 60 days (Thind *et al.* 1995). Hence, it is necessary to control weeds at the early stages of crop growth to achieve the desired productivity. It

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is a common practice with the farmers of taking manual weeding 4–5 times depending on intensity of weed infestation and availability of labour. Often the farmers tend to weed out excessively thus increasing the cost. Hence the experiment was conducted to find out an optimum weed-free period for onion – chilli – cotton relay intercropping system under rainfed conditions in Vertisols.

MATERIALS AND METHODS

A field experiment was conducted at Water Management Research Centre, Belvatagi, University of Agricultural Sciences, Dharwad during 2005-06 and 2006-07. The Centre is at N 15.61⁰ longitude and E 75.23⁰ latitude and 579 m above mean sea level. The soil was clay with a pH of 8.20, low in available nitrogen (242 kg/ha), medium in available phosphorus (25 kg/ha) and high in available potassium (820 kg/ha). A total rainfall of 492.1 mm and 443.0 mm were received during 2005 and 2006, respectively. The experiment was conducted in completely randomized block design with 3 replications. The treatments include weed-free period up to 20, 40, 60, 80, 100 and 120 days after sowing weed-free between 20 and 120 days after sowing, weed-free between 40 and 120 days after sowing, weedy check weed-free check for the entire period of onion + chilli + cotton.

The 'Bellary Red' onion, 'Byadagi Kaddi' chilli and 'Jayadhar' cotton were used in the experiment. Onion and chilli were hand-drilled simultaneously in separate rows @

7.5 kg/ha and 5.0 kg/ha, respectively. Distance between row-to-row of onion was 15 cm, while 90 cm for chilli. Sowing was done on 14 July 2005 and 28 June 2006. Cotton seeds were dibbled @ 3 kg/ha on 30 September 2005 and 16 September 2006. Planting of cotton was done in rows at 45 cm apart from chilli row while, 40 cm was maintained within the row. Recommended package of practices were followed for nutrient and pest management. Weed-free condition was obtained by frequent hand weeding as per the treatment. Weed-free condition was maintained by hand weeding (2, 3, 4, 5, 6, 7, 6, 5, 0 and 8 times in treatments from 1 to 10) as and when weeds appeared throughout the crop growth period. Weed population/m² and weed dry weight (g/m²) were recorded at 20,40,60,80, 100 and 120 days after sowing, but before weeding. The data on number and dry weight of weeds were subjected to square root transformation " $\sqrt{x + 0.5}$ " before statistical analysis. Treatments were subjected to Duncan's Multiple Range Test for comparison.

RESULTS AND DISCUSSION

The major monocot weeds associated with crops in the field were *Cynodon dactylon* Pers. (Bermuda grass), *Brachiaria eruciformis* Roem and Schult. and *Dinebra retroflexa* Panz.. While, among broad-leaved weeds, *Abutilon indicum* G. Don., *Acanthospermum hispidum* L. *Ageratum*

conyzoides L., *Alternanthera sessilis* L., *Amaranthus viridis* L., *Cynotis cristata* L., *Convolvulus arvensis* L., *Commelina benghalensis* L., *Crozophora rotleri*, *Desmodium diffusum* Dc., *Digera arvensis* L., *Euphorbia hirta*. (L.) Forssk., *Hibiscus* spp, *Lactuca runcinata* Dc., *Lagasca mollis* Car., *Parthenium hysterophorus* L., *Phyllanthus maderaspatensis* L., *Physalis minima* L., *Portulaca oleracea* L. were observed. *Cyperus rotundus* L. was the only sedge observed in the experiment. *Hibiscus* sp., *Desmodium diffusum* and *Brachiaria eruciformis* were predominant.

Weed dry weight

Dry weight of weeds increased from 20 to 120 days after sowing in all weed-free periods as a consequence of increase in the number of weeds (Table 1). The weed-free periods were effective in reducing weed dry weight compared to weedy check up to 100 days after sowing. Weedy check recorded significantly higher weed dry weight at all the stages. The weed dry matter accumulated in weed-free up to 20 days after sowing was also higher after weedy check from 60 days after sowing onwards. Weed-free condition up to 100 days after sowing was as good as weed-free check with zero weed dry weight.

Dry weight of weeds at 20 days after sowing ($r = -0.832$) and 40 days after sowing ($r = -0.917$) were critical for the

Table 1 Total number and dry weight of weeds/m² at different growth stages as influenced by crop-weed competition in direct-seeded onion – chilli – cotton relay intercropping (pool of 2005–06 and 2006–07)

Treatment	Weeds/m ² at DAS						Dry weight (g/m ²) at DAS					
	20	40	60	80	100	120	20	40	60	80	100	120
Weed-free up to first 20 DAS	0.71 d (0.0)	2.18 c (5.17)	3.37 b (12.83)	3.44 b (13.0)	4.53 b (21.17)	4.75 b (23.17)	0.71 d (0.0)	7.53 c (56.60)	12.99 b (177.39)	18.64 b (379.63)	23.26 b (543.13)	26.86 b (727.65)
Weed-free up to first 40 DAS	0.71 d (0.0)	0.71 d (0.0)	2.68 c (10.0)	3.57 b (16.67)	4.41 bc (21.0)	4.60 b (22.83)	0.71 d (0.0)	0.71 d (0.0)	4.80 c (26.45)	12.90 c (178.07)	18.65 c (352.20)	20.60 (429.67)
Weed-free up to first 60 DAS	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	2.27 c (6.17)	3.88 bc (15.17)	4.10 b (17.17)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	2.71 d (7.42)	12.35 d (155.17)	14.14 d (203.72)
Weed-free up to first 80 DAS	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	3.31 c (12.17)	3.54 b (13.50)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	10.44 d (121.65)	11.97 d (148.17)
Weed-free up to first 100 DAS	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	3.75 b (14.33)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 e (0.0)	6.56 e (51.84)
Weed-free up to first 120 DAS	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 c (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 e (0.0)	0.71 f (0.0)
Weedy up to first 20 DAS	5.55 b (31.33)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 c (0.0)	5.32 b (31.85)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 e (0.0)	0.71 f (0.0)
Weedy up to first 40 DAS	4.88 c (23.50)	5.06 b (25.83)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 c (0.0)	4.64 c (23.15)	13.05 b (179.58)	0.71 d (0.0)	0.71 d (0.0)	0.71 e (0.0)	0.71 f (0.0)
Weedy check	6.65 a (45.83)	6.08 a (38.50)	5.31 a (34.0)	5.16 a (31.0)	5.66 a (35.67)	5.97 a (38.67)	8.25 a (82.41)	14.94 a (229.07)	19.62 a (413.11)	25.38 a (650.43)	28.30 a (806.83)	29.44 a (870.39)
Weed-free check	0.71 d (0.0)	0.71 d (0.00)	0.71 d (0.00)	0.71 d (0.0)	0.71 d (0.0)	0.71 c (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 d (0.0)	0.71 e (0.0)	0.71 f (0.0)
SEm +	0.15	0.28	0.21	0.29	0.38	0.40	0.19	0.60	0.92	0.93	0.71	0.79
CD (P=0.05)	0.44	0.82	0.61	0.82	1.08	1.16	0.56	1.73	2.63	2.67	2.04	2.29

Figures in the parentheses are original values; Figures with the same letters do not differ significantly by Duncan's Multiple Range Test; $\sqrt{(X + 0.5)}$ transformation values; DAS, Days after sowing

onion yield as they were more negatively correlated compared to weed dry weight at 60, 80, 100 and 120 days after sowing. Weed dry weight at 100 days after sowing ($r = -0.75$) and 120 days after sowing ($r = -0.71$) were less effective on the onion yield. However, the weed dry weight at later stage of 60 days after sowing ($r = -0.882$), 80 days after sowing ($r = -0.900$) and 100 days after sowing ($r = -0.902$) were determining factors for chilli yield as it was more negatively correlated.

Onion

Onion bulb yield was significantly higher with weed-free check (13.50 tonnes/ha) compared to all other treatments except weed-free up to 100 days after sowing (11.30 tonnes/ha) and 120 days after sowing (12.52 tonnes/ha) with which it was at par. Bulb yields obtained in weed-free up to 60 days after sowing (10.27 tonnes/ha), 80 days after sowing (10.67 tonnes/ha), 100 days after sowing and 120 days after sowing were at par. Maximum yield was achieved by maintaining weed-free period up to 100 days after sowing (11.30 tonnes/ha) and this accounted for 84% of weed free check, and further increase in weed-free condition did not increase the bulb yield significantly. The increase in yield by maintaining weed-free up to 100 days after sowing was due to better bulb weight (13.67 g) than weedy check. Significantly lower bulb yield was recorded in weedy check (0.12 tonnes/ha) compared to rest of the treatments. Bulb yields obtained in weed-free period between 40 and 120 days after sowing (5.01 tonnes/ha) and weed-free up to 20 days after sowing (6.43 tonnes/ha) were at par. Keeping weed free up to 40 days after sowing (9.69 tonnes/ha) resulted in significantly higher bulb yield compared to weed-free up to 20 days after sowing and weedy up to first 40 days after sowing and was at par with weed-free up to 60, 80, 100 and weedy up to first 20 days after sowing (Table 2).

Weed-free up to 40 days after sowing (9.69 tonnes/ha) was better than weedy up to 40 days after sowing (5.01 tonnes/ha) and was at par with weed-free up to 100 days after sowing (11.30 tonnes/ha). Longer initial weed-free periods from 15 days to 90 days significantly increased the bulb diameter resulting in increased bulb yields and maintaining weed-free period for a short period in the beginning of the crop growth stage was not sufficient for higher yields (Westra *et al.* 1990 and Kalyanamurthy 2002).

Maintaining weed-free condition up to 120 days after sowing (11.46 tonnes/ha) was necessary to achieve higher yields as that of weed-free condition (12.61 tonnes/ha). This may be attributed to higher bulb weight (13.70 g) and lesser unmarketable yield (8.20%) compared to weedy check. Similar increase in the smaller bulbs was noticed when weeds were allowed to compete with onion for 8 weeks (Rameshwar *et al.* 2001). When weed-free condition was increased from 15 days after sowing to 75 days after sowing, number of larger onion bulbs increased from 1.5% to 39% resulting higher marketable bulb yield (Kalyanamurthy 2002). Weed-free periods did not influence the total soluble solids of onion bulbs.

Chilli

In general, all the weed-free periods significantly reduced the chilli fruit yield over weed-free condition (Table 3). Chilli fruit yield was significantly high when the plot was kept weed-free throughout the crop growth period with 1 091 kg/ha. Weed-free condition up to 100 days or more after sowing resulted in at par fruit yield (884 kg/ha) with weed-free check. Maintaining weed-free condition up to 20 days (500 kg/ha) or 40 days (568 kg/ha) was not sufficient and significantly reduced the fruit yield. Weedy check significantly reduced the fruit yield (3.67 kg/ha) of chilli. The increase in fruit yield due to weed-free periods can be attributed to improved

Table 2. Yield parameters, yield and quality of onion as influenced by crop-weed competition in direct-seeded onion–chilli–cotton relay intercropping (pool of 2005–06 and 2006–07)

Treatment	Bulb length (cm)	Bulb diameter (cm)	Bulb weight (g)	Marketable bulb yield (tonnes/ha)	Bulb yield (tonnes/ha)	TSS (%)
Weed-free up to first 20 DAS	4.62 bc	3.34 a-c	12.48 ab	5.66 d	6.43 d	8.72
Weed-free up to first 40 DAS	4.65 bc	3.40 a-c	14.75 a	8.77 c	9.69 c	9.52
Weed-free up to first 60 DAS	4.74 a-c	3.63 a-c	14.53 a	8.98 c	10.27 bc	10.23
Weed-free up to first 80 DAS	4.84 ab	3.92 ab	14.98 a	9.84 bc	10.67 bc	10.40
Weed-free up to first 100 DAS	4.96 ab	3.65 a-c	13.67 a	10.32 bc	11.30 a-c	10.65
Weed-free up to first 120 DAS	5.02 ab	4.15 a	13.70 a	11.46 ab	12.52 ab	10.75
Weedy up to first 20 DAS	5.20 ab	3.17 bc	13.47 a	8.19 c	9.07 c	9.57
Weedy up to first 40 DAS	3.94 c	2.93 c	10.85 b	4.34 d	5.01 d	8.55
Weedy check	2.06 d	1.36 d	2.60 c	0.03 e	0.12 e	8.90
Weed-free check	5.59 a	3.99 ab	15.33 a	12.61 a	13.50 a	10.27
SEm +	0.27	0.26	0.86	0.74	0.75	0.69
CD ($P=0.05$)	0.78	0.76	2.56	2.13	2.16	NS

Figures with the same letters do not differ significantly by Duncan's Multiple Range Test; DAS, Days after sowing

Table 3 Yield parameters, yield and quality of chilli as influenced by crop-weed competition in direct seeded onion–chilli–cotton relay intercropping (pool of 2005–06 and 2006–07)

Treatment	Branches/ plant	Fruits/ plant	Fruit weight/ plant (g)	Fruit yield (kg/ha)	Weed index (%)	Colour index	Ascorbic acid (mg/100 g)	TSS (%)
Weed-free up to first 20 DAS	5.50 cd	2.37 bc	2.39 bc	500 e	54.17	4.43 ab	196.8 c	7.01 ab
Weed-free up to first 40 DAS	7.17 b-d	2.45 bc	2.80 bc	568 de	47.85	4.55 ab	204.0 c	8.37 ab
Weed-free up to first 60 DAS	6.83 b-d	2.48 bc	5.48 a-c	752 b-d	31.07	4.63 a	286.3 a	9.97 a
Weed-free up to first 80 DAS	7.67 bc	3.80 a-c	6.32 a-c	793 bc	27.22	4.63 a	229.5 a-c	9.56 ab
Weed-free up to first 100 DAS	9.17 ab	4.27 a-c	9.02 ab	884 ab	18.97	4.71 a	252.5 a-c	8.33 ab
Weed-free up to first 120 DAS	10.33 a	4.83 ab	7.50 a-c	945 ab	13.38	4.83 a	232.2 a-c	9.40 ab
Weedy up to first 20 DAS	10.17 a	3.46 a-c	3.59 bc	854 c	21.72	4.63 a	276.5 ab	9.51 ab
Weedy up to first 40 DAS	6.67 cd	3.26 a-c	3.38 bc	609 c-e	44.18	4.48 ab	237.0 a-c	6.65 b
Weedy check	4.83 d	0.12 c	0.058 c	3.67 f	99.67	4.17 b	218.0 bc	7.32 ab
Weed-free check	10.83 a	6.85 a	11.85 a	1091 a		4.71 a	231.0 a-c	8.24 ab
SEm ±	0.77	1.28	2.39	70.61		0.14	20.55	0.90
CD (P=0.05)	2.26	3.66	6.86	202.5		0.39	58.94	2.59

Figures with the same letters do not differ significantly by Duncan's Multiple Range Test; DAS, Days after sowing

yield parameters. Number of branches/plant required minimum weed-free period of 100 days (9.17) to produce at par branches as observed in weed-free check (10.83). Numbers of branches were significantly reduced when weeds were present for the initial periods of 20, 40, 60 or 80 days and weedy up to 40 days after sowing as that of weedy check (4.83). Number of fruits/plant was less sensitive and required 80 days weed free period (3.80) to produce similar fruits as that of weed-free check (6.85). Higher fruit weight/plant was observed when weed-free condition was maintained up to 60 days (5.48 g) or more. Similar findings were reported by Tei (1988).

Weedy check and initial weed-free periods up to 40 days after sowing reduced the ascorbic acid content of chilli fruits. Weed-free up to 60 days or more was required for higher ascorbic acid content similar to that of weed-free check. Higher availability of nutrients improved the ascorbic acid content of chilli fruits. This is in conformity with the findings of Prabhavathi *et al.* (2008).

Colour of chilli fruit changed from dark-red to brick-red due to weed interference throughout the period of chilli growth or for the first 40 days only (Table 3). Maintaining weed-free period for 20 or 40 days after sowing also changed the colour of fruits. Keeping the field weed-free up to 60 days after sowing or more was effective similar to weed-free check.

Cotton

Significantly higher seed cotton yield was obtained in weed-free between 40 and 120 days after sowing (344.60 kg/ha) compared to weed-free up to 20, 40 and weedy check (Table 4). Whereas, the yield obtained in weed-free up to 120 days after sowing was 180.80 kg/ha and this was at par with weed-free up to 60 days after sowing (89.68 kg/ha), 80 days after sowing (97.94 kg/ha), 100 days after sowing

(132.40 kg/ha), 20 – 120 days after sowing (148.52 kg/ha) and weed-free check (115.90 kg/ha). Significantly lower seed cotton yield was obtained in weedy check (0.06 kg/ha) compared to all the treatments except weed-free up to 20 and 40 days after sowing with which it was at par. Weedy check resulted in higher weed index (99.95%) compared to other treatments. Similar higher weed index was obtained in weed-free up to 20 days after sowing (98.18%) and 40 days after sowing (97.89%).

Weedy up to 40 days after sowing of onion and chilli and weed-free later significantly improved the seed cotton yield (344.60 kg/ha) compared to weed-free check (115.9 kg/ha) and other weed-free periods. This increase was by 197% more than weed-free check. Weedy condition up to 40 days after sowing in onion and chilli affected its growth and weed-free after the sowing of cotton significantly improved the cotton yield parameters, like number of monopodials (2.0/plant), number of sympodials (2.67/plant), number of bolls (6.0/plant), boll weight (10.78/plant) and seed cotton yield (6.15 g/plant) in comparison to weedy check. Weed dry weight at 20 days after sowing did not affect the seed cotton yield ($r = -0.103$). Similar effect was observed with weed dry weight at 40 days after sowing ($r = 0.121$). However, weed dry weight at 60 days after sowing ($r = -0.537$), 80 days after sowing ($r = -0.636$), 100 days after sowing ($r = -0.727$) and 120 days after sowing ($r = -0.751$) were more negatively correlated with seed cotton yield.

Weed-free up to 60 days after sowing or more resulted in significantly higher lint index and seed index compared to weedy check; weed-free up to 20 and 40 days after sowing. These results are in conformity with the seed cotton yields where weed-free period up to 40 days after sowing is not required for high cotton yields. However, ginning percentage was unaffected by weed-free periods except weedy check.

It can be concluded that onion – chilli – cotton relay

Table 4 Seed cotton yield, yield parameters and quality of cotton as influenced by crop-weed competition in direct-seeded onion–chilli–cotton relay intercropping (data pertains to 2006–07 and no yield was obtained during 2005–06)

Treatment	Monopodials/ plant *	Sympodials/ plant *	No. of bolls/ plant *	Boll wt/ plant (g)*	Seed cotton yield/ plant (g)*	Seed cotton yield (kg/ha) *	Weed index cotton (%)	Lint index (g)**	Seed index (g) **	Ginning (%) ***
Weed-free up to first 20 DAS	1.34 a (1.33)	1.46 ab (1.67)	1.22 bc (1.00)	1.07 b (0.65)	0.87 b (0.28)	1.60 c (2.07)	98.18	0.19 b (0.61)	0.36 c (1.37)	33.50 ab (30.46)
Weed-free up to first 40 DAS	1.23 a (1.00)	1.17 b (1.00)	1.86 ab (3.17)	2.21 a (4.65)	1.67 ab (2.37)	1.41 c (2.44)	97.89	0.27 b (0.85)	0.49 b (2.08)	32.62 ab (29.08)
Weed-free up to first 60 DAS	1.34 a (1.33)	1.46 ab (1.67)	1.95 ab (3.50)	2.24 a (4.77)	1.97 a (3.58)	9.37 b (89.68)	22.62	0.66 a (3.55)	0.85 a (6.10)	37.34 a (36.80)
Weed-free up to first 80 DAS	1.44 a (1.67)	1.58 ab (2.00)	2.16 ab (4.33)	2.61 a (6.82)	2.18 a (4.55)	9.10 b (97.94)	15.49	0.62 a (3.17)	0.84 a (5.98)	35.97 ab (34.53)
Weed-free up to first 100 DAS	1.34 a (1.33)	1.58 ab (2.00)	2.13 ab (4.17)	2.77 a (7.35)	2.01 a (4.70)	11.20 b (132.40)	-14.23	0.66 a (3.60)	0.85 a (6.04)	37.66 a (37.37)
Weed-free up to first 120 DAS	1.46 a (1.67)	1.68 a (2.33)	2.28 a (4.83)	2.94 a (8.38)	2.33 a (5.18)	12.48 ab (180.80)	-55.99	0.64 a (3.38)	0.85 a (6.20)	36.42 ab (35.27)
Weedy up to first 20 DAS	1.46 a (1.67)	1.34 ab (1.33)	2.23 ab (5.83)	3.12 a (10.30)	2.47 a (5.82)	11.43 b (148.52)	-28.14	0.63 a (3.26)	0.84 a (5.92)	36.56 ab (35.50)
Weedy up to first 40 DAS	1.56 a (2.00)	1.77 a (2.67)	2.51 a (6.00)	3.27 a (10.78)	2.57 a (6.15)	18.22 a (344.60)	-197.32	0.59 a (2.90)	0.83 a (5.79)	35.26 ab (33.37)
Weedy check	0.71 b (27.33)	0.71 c (0.0)	0.79 c (0.0)	0.75 b (0.13)	0.73 b (0.06)	0.75 c (0.04)	99.95 (0.06)	0.04 c	0.10 d (0.10)	31.49 b (0.27)
Weed-free check	1.34 a (1.33)	1.46 ab (1.67)	2.24 ab (4.67)	3.13 a (9.57)	2.32 a (5.13)	10.77 b (115.90)		0.64 a (3.67)	0.85 a (6.19)	36.50 ab (35.76)
SEm +	0.13	0.13	0.31	0.33	0.31	2.10		0.04	0.02	1.58
CD (P=0.05)	0.39	0.39	0.93	0.99	0.91	6.25		0.12	0.07	4.71

Figures in the parentheses are original values; Figures with the same letters do not differ significantly by Duncan's Multiple Range Test * $\sqrt{(X + 0.5)}$ transformation values ** $X + 1$ log trans, *** Arcsine percentage transformation; DAS, days after sowing

intercropping system requires weed-free period of 120 days for sowing of onion and chilli for higher yield under rainfed conditions in Vertisols of northern Karnataka.

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