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Satish Kumar
Deptt of Agronomy, Doon PG College of Agriculture Science and Technology, Dehradun, Uttarakhand, India

Pradeep Mishra
Deptt of Agronomy, Doon PG College of Agriculture Science and Technology, Dehradun, Uttarakhand, India

Preetam Singh
Deptt of Agronomy, Dr Bhim Rao Ambedkar University, Agra, UP, India

Kavita Sinha
DPD, ATMA, Kanker, Chhattisgarh, India

Correspondence
Satish Kumar
Deptt of Agronomy, Doon PG College of Agriculture Science and Technology, Dehradun, Uttarakhand, India

Effect of different weed control practices on growth of Urd Bean

Satish Kumar, Pradeep Mishra, Preetam Singh and Kavita Sinha

Abstract
A field experiment was conducted to study **"**Effect of different weed control practices on growth of Urd Bean". The experiment was laid in randomized block design with three replications. The treatment comprised of eleven weed management practices (viz., T_1 : weedy check, T_2 : hand weeding twice at 20 and 40 DAS, T_3 : pendimethalin @ 1000 g ha^{-1} PE, T_4 : Quizalofop-p-ethyl @ 37.5 g ha^{-1} PoE (20 DAS), T_5 : Fenoxaprop-p-ethyl @ 50 g ha^{-1} PoE (20 DAS), T_6 : Pendimethalin 30EC + imazethapyr 2EC (Vallore 32) @ 750 g ha^{-1} PE (2 DAS), T_7 : Pendimethalin 30EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1} PE (2 DAS), T_8 : Imazethapyr @ 25 g ha^{-1} PoE (20 DAS), T_9 : Imazethapyr @ 40 g ha^{-1} PoE (20 DAS), T_{10} : Imazethapyr @ 55 g ha^{-1} PoE (20 DAS), T_{11} : Weed free plot). Significantly plant population, greater plant height, more number of leaves, maximum leaf area index, higher number of branches, dry matter accumulation, number of nodules and dry weight of nodules were obtained under weed free treatments, followed by hand weeding twice at 20 and 40 DAS and imazethapyr @ 40 g ha^{-1} PoE (T_9) and minimum was obtained under weedy check.

Keywords: Urdbean, weed, growth, nodules

1. Introduction
Urdbean (*Phaseolus mungo* L.) is also known as blackgram or mashbean, is one of the important Kharif pulse crop grown throughout the India, next to green gram. It is consumed in form of „dal" (whole or split, husked or unhusked) or parched. It is chief constituent of "papad" and also of "bari" (spiced balls) which make a delicious curry. It differs from other pulses in its peculiarity of attaining when up with water a somewhat mucilaginous pasty character, giving additional body to the mass. In the south, the husked dal is ground into a fine paste and allowed to ferment and is mixed with equal quantity of rice flour or makes "dosa" and "idli". It is also fried to serve as savoury dish. Urd dal is also use in the preparation of "halwa" and "imarti". It is used as a nutritive fodder especially for feeding cattle. It is also used as a green manuring crop. Urdbean plant possesses deep root system which binds soil particles and thus prevents soil erosion besides builds up soil fertility as it fixes about 70-90 kg N ha^{-1}. Urd grain contains about 24 per cent protein, 60 per cent carbohydrates, 1.3 per cent fat, and is the richest among the various pulses in phosphoric acid.Urdbean is mainly grown in tropical and sub-tropical climate. Urdbean is a native of India and originated from wild plant i.e. *Phaseolussublobatus*. It occupies sizable area in India, Bangladesh, Pakistan, Myanmar, Sri Lanka, and West indies. It is grown all over country in kharif and summer seasons also, while in south India, it is raised mainly in rabi season. Urdbean contributed 13 per cent in total pulses area and 10 percent in total pulses production of India. Urdbean occupies 29.68 lakh ha and contributed nearly 12.45 lakh tones to pulse production with an average productivity of 419 kg/ha. In India, Uttar Pradesh, Maharashtra, Madhya Pradesh, Tamilnadu, Odisha, Chhattisgarh, Karnataka, Gujrat, Jharkhand, West Bengal, Assam, Uttranchal and Bihar are the major urd producing states.

In general it is grown as sole crop in kharif and also under residual moisture condition after the harvest of rice (utera crop) as well as grown during summer in irrigated areas. It occupies an area of 182.52 thousands ha (kharif) and 9.70 thousands ha (Rabi) with production of 74.41 thousands tones and 4.09 thousands tones and average productivity of 408 kg ha-^{1} and 310 kg/ha respectively. Based on the area under cultivation in Chhattisgarh, the major urdbean growing districts are Raigarh (18290 ha) followed by Sarguja (15012 ha), Jashpur (14663 ha), Mahasamund (10128 ha) and Baster (9790 ha) while Jashpur (5021 metric tones), Raigarh (4221 metric tones), Baster (4012 metric tones), Sarguja (2604 metric tones) and Mahasamund (2350 metric tones) accounted for maximum production (Anonymous 2011) [1].

Uncontrolled

Weeds at critical period of crop-weed competition caused a reduction of 80-90% in black gram yield depending upon type and intensity of weed infestation (Kumar *et al.,* 2001) [7]. To control weed the traditional method of weed control i.e. hand weeding although effective but it is expensive, tedious and time consuming (Yadav *et al*., 2009) [17]. Moreover, hand weeding and mechanical weeding are difficult due to continuous rainfall and less availability of labours at the critical stage of crop-weed competition. Use of herbicide not only improve crop yield but also makes available significant labour for other productive activities (Kurchania *et al*., 1989) [8]. Weed competition is one of the prime yields limiting biotic constraint in pulse production during kharif season. Urdbean in particular, is infested by heterogenous types of weed flora under rainfed uplands. Weed species infesting urdbean vary according to the agro-ecosystem of the growing region. *Trianthemaportulacastrum, Convolvulus arvensis, Cyperusrotundus, Cynodondactylon*, and *Eleusineaegyptica* are the major weeds in urdbean (Randhawa *et al.,* 2002) [12]. Most prominent weed species found in urdbean fields are Trianthemaportulacastrum, Cyperusrotundus, Euphorbia hirta, and Phyllanthusniruri (Raman *et al.,* 2005) [10]. Echinocloacolanum, Panicumrepens, Cyperusrotundus, Eclipta alba, Phyllanthusniruri, Digraarvensis, Celosia argensia and Commelinabenghalensis (Begum *et al.,* 2006) [3]. Alleviating weed competition through weed management practices was found to be effective in enhancing crop yield of urdbean. The use of selective herbicides in urdbean seems to be effective and economical. However, effectiveness depends upon the weed flora and their time of emergence. The traditional methods of weed control viz. manual and mechanical methods are cumbersome and time consuming and hence prove costly. However, many a times non-availability of labourers at critical period leads to ineffective control of weeds and severe crop-weed competition. The crop- weed competition starts from the beginning, since the crop and weed emerge simultaneously, thus, warrants the suitable weed management practices to get effective, timely and economical control of weeds in urdbean. Therefore, it is of paramount importance that the weeds are to be kept under check right from the beginning for efficient utilization of applied inputs. To overcome this problem, an effective and efficient weed management practice needs to be developed for the agro- ecological situations of UK plains. Keeping these points in view, the present investigation was conducted to see the effect of different weed control practices on growth and Yield of Urd Bean.

2. Materials and Methods

An experiment was conducted to see the effect of different weed control practices on growth and Yield of Urd Bean (Pant Urd) during kharif season (July to October) of 2013. The field experiment was carried out during Kharif season of 2013 at the Rampur Agriculture farm selaqui, Dehradun (U.K.). The general climatic condition of Dehradun is sub-humid to semi-arid with mean annual rainfall of 1325 mm of which 85 per cent is received during June to September and the rest 15 per cent fall during October to February. The weekly maximum temperature raises upto 460C during summer and minimum temperature drop down as 60C during winter season, respectively. May and December are the hottest and coolest months, respectively. Atmospheric humidity varies between 70 to 90 per cent from mid June to March and wind velocity is high from May to August with its peak in June to July months. The crop received 1182.2 mm of rainfall during the entire growth period. The maximum temperature during this period varied between 33.4°C in first week of July to 28.°C in the first week of September, whereas, minimum temperature varied between 17.7°C in the fourth week of October to 32.8 °C in third week of August.

2.1. Experimental details

The experiment was laid out in Randomized Block Design with 11 (eleven) treatment and replicated thrice. The details of the treatments are presented below.

Treatment Details

Notations	Treatment	Dose (g ha^{-1})	Time of application
T_1	weedy check	_	_
T_2	Hand weeding	_	20 and 40 DAS
T_3	Pendimethalin	1000	20 DAS PE
T_4	Quizalofop – p – ethyl	37.5	20 DAS PoE
T_5	Fenoxaprop – p- ethyl	50	20 DAS PoE
T_6	Pendimethalin 30EC +Imazethapyr EC (Vallore 32)	750	20 DAS PE
T_7	Pendimethalin 30EC +Imazethapyr EC (Vallore 32)	1000	20 DAS PE
T_8	Imazethapyr	25	20 DAS PoE
T_9	Imazethapyr	40	20 DAS PoE
T_{10}	Imazethapyr	55	20 DAS PoE
T_{11}	Weed free plot		

PE =Pre – emergence, PoE = post – emergence, DAS = Days after sowing

2.2. Plant population (No. m^2)

Plant population per square metre area was recorded at 20 DAS and at harvest from three randomly selected spots in each plot to estimate the plant population m^2.

2.3. Plant height (cm)

Plant height of five tagged plants in each plot was measured at an intervals of 20, 40, 60 DAS and at harvest then average was worked out.

2.4. Number of leaves plant^{-1}

Number of leaves of five tagged plants in each plot was counted at 20, 40 and 60 DAS and then average was worked out.

2.5. Number of branches plant^{-1}

Number of branches of five tagged plants in each plot were recorded at 20, 40, 60 DAS and at harvest and then average was worked out.

2.6. Dry matter accumulation (g plant^{-1})

The dry matter accumulation of plants was recorded at 20, 40, 60 DAS and at harvest. Five plants were uprooted from each plot randomly. These samples of plants were kept in paper bags and dried in an oven at 600C till their weight become constant. After that the weight was recorded on electronic balance.

2.7. Number of nodules plant^{-1}

Number of nodules of five randomly selected plants in each plot was counted at 25 and 50 DAS and average number of nodules plant^{-1} was worked out.

2.8. Dry weight of nodules (mg)
Dry weight of nodules per plant was recorded at successive intervals. Five randomly selected plants from each plot which are already uprooted for counting of nodules, were washed and nodules were detached and oven dried at 600C for 48 hours.

2.9. Statistical analysis
The data obtained on various parameters were tabulated and subjected to statistical analysis. The data on weed density and dry matter production of weeds were subjected to square root transformation i.e. + 0.5 before carrying analysis of variance. The influence of treatment was tested with „F" test, wherever „F" test shown their significance, the levels of treatment were compared by critical difference at 5% level of probability.

3. Results and Discussions
3.1. Plant population (No. m²)
The data with respect to plant population are presented in Table 1. Plant populations (m²) recorded at 20 DAS and at harvest clearly indicated that the plant population of urdbeandid not varied significantly due to different weed management treatments. In general plant population recorded at 20 DAS ranged between 33.33 to 35 plant m² whereas plant population at harvest ranged from 29.67 to 34.33 plant m². The plant population is prime factor for getting maximum yield. The maximum yield potential of individual plant achieved when less crop-weed competition for different growth factors resulted proper utilization of light, water and nutrients etc.

Table 1: Plant population and Plant height (cm) of urdbean as effected by weed management practices

Treatment	Plant population m²		Plant height (cm)			
	20 Das at harvest		20 Das	40 Das	60 Das	At harvest
T_1 Weedy check	34.33	29.67	15.71	26.41	34.13	39.46
T_2 Hand weeding twice	34.33	33.33	17.97	33.73	45.31	48.98
T_3Pendimethaln	33.33	31.33	17.68	27.50	40.05	43.37
T_4Quizalofop-p-ethyl	34.00	32.00	16.94	26.77	39.17	42.89
T_5Fenoxaprop-p-ethyl	34.00	30.67	17.24	26.33	38.40	41.72
T_6Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	33.33	32.00	17.67	31.67	42.39	46.23
T_7Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	33.67	32.00	18.06	32.13	43.57	47.07
T_8Imazethapyr	34.00	32.33	17.83	28.95	40.55	44.23
T_9Imazethapyr	34.00	32.00	17.71	33.27	44.45	48.01
T_{10}Imazethapyr	33.67	32.33	16.77	30.53	41.43	44.92
T_{11}Weed free plot	35.00	34.33	17.54	24.83	48.87	50.77
SEm±	2.06	1.96	1.06	1.80	2.56	2.19
CD (p=0.05)	NS	NS	NS	5.32	7.55	6.46

3.2. Plant height (cm)
The data on plant height of urdbean at 20, 40, 60 DAS and at harvest as influenced by different weed management practices are presented in Table 1. Irrespective of treatments, plant height in general, increased progressively over time, but sharp increase in height was observed in between 20 to 60 DAS in all the treatments and afterwards, it increased with slow pace. Various weed management treatments had significant influenced on plant height at all the stages of observation, except at 20 DAS, where the differences in plant height was non-significant.

Weed free plot (T_{11}) recorded significantly taller plant during all the stages of observation followed by a plant height obtained under hand weeded plot, twice at 20 and 40 DAS (T_2), pendimethalin 30 EC + imazethapyr 2EC (Vallore 32) @ 750 g ha^{-1} (T_6), pendimethalin 30EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1} (T_7) and imazethapyr @ 40 g ha^{-1} (T_9) and imazethapyr @ 55 g ha^{-1} (T_{10}) which were statistically at par, all stages of observation. The lowest plant height was observed under weedy check across all the periods of observation. Data clearly indicates that the tallest plant recorded in weed free treatment over weedy control which might be due to less crop-weed competition for different growth factor resulted proper utilization of solar radiation, water, nutrients, etc. where as in control plot because of more crop-weed competition, plants unable to obtain water and nutrients in sufficient quantity resulted lowest height. Nirala (2010) [9] also found that significantly highest plant height was recorded under imazethapyr @ 25 g ha^{-1} at 20 DAS and hand weeding twice (20 and 40 DAS) at all time interval except at 20 DAS. Similar results have been reported by Gowda (2005) [5]. And Tiwari *et al*. (2006) [13].

3.3. Number of leaves plant^{-1}
Data on the number of leaves plant^{-1} at 20, 40 and 60 DAS as influenced by different weed control treatments are presented in Table 2. In general it was observed that the number of leaves plant^{-1} increased with the advancement of crop age up to 60 DAS.

At the initial stage of crop growth (20 DAS) leaf production remained unaffected due to different treatments. However, at 40 and 60 DAS significantly maximum number of leaves plant^{-1} was recorded from weed free plot (T_{11}), however, it was at par with results obtained from hand weeding twice at 20 and 40 DAS (T_2), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 750 g ha^{-1} pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1}imazethapyr @ 40 g ha^{-1} (T_9) at 60 DAS while, imazethapyr @ 55 g ha^{-1} (T_{10}) at 40 DAS. On the other hand the lower number of leaves plant^{-1} was recorded under weedy check. Nirala (2010) [9] also reported the highest number of leaves under hand weeding twice 20 and 40 DAS. This might be due to comparatively less crop-weed competition under these treatments, which allowed more utilization of light, water and nutrients. Weedy check produced the lowest number of leaves; it was mainly due to adverse effect of excessive crop-weed competition.

Table 2: Number of leaves (plant^{-1}) and Leaf Area Index of urdbean as affected by weed management practices

Treatment	Number of leaves (plant^{-1})			Leaf Area Index		
	20 Das	40 Das	60 Das	20 Das	40 Das	60 Das
T_1 Weedy check	8.07	12.80	15.03	0.30	1.98	2.92
T_2 Hand weeding twice	8.33	17.00	18.60	0.33	2.51	3.79
T_3Pendimethaln	8.53	13.87	15.07	0.41	2.23	3.26
T_4Quizalofop-p-ethyl	8.33	13.53	15.47	0.31	2.23	3.21
T_5Fenoxaprop-p-ethyl	8.33	13.40	15.26	0.29	2.21	3.20
T_6Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	8.60	15.00	16.73	0.43	2.24	3.48
T_7Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	8.60	15.80	16.93	0.43	2.44	3.52
T_8Imazethapyr	8.53	14.00	16.07	0.31	2.33	3.39
T_9Imazethapyr	8.73	16.47	17.93	0.36	2.49	3.61
T_{10}Imazethapyr	8.40	14.73	16.20	0.34	2.36	3.44
T_{11}Weed free plot	9.07	17.67	19.47	0.45	2.69	3.87
SEm±	0.58	1.01	0.97	0.02	0.12	0.18
CD (p=0.05)	NS	2.98	2.87	0.07	0.34	0.52

3.4. Leaf area index

The data on leaf area index of urdbean as influenced by different weed management practices are presented in Table 2. Results revealed that LAI in urdbean varied significantly due to various weed management practices. At 20 DAS, weed free plot (T_{11}) proved to be the best in enhancing the leaf area index and it was at par with the result obtained from plot treated with pendimethalin @ 1000 g ha^{-1} (T_2), pendimethalin 30EC + imazethapyr 2 EC (Vallore 32) @ 750 g ha-1 (T_6) and pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1} (T_7). Where as at 40 DAS, significantly higher leaf area index was observed under treatments weed free plot (T_{11}) and, it was comparable to the results obtained from hand weeding twice at 20 and 40 DAS (T_2), pendimethalin 30EC + imazethyper 2EC (Vallare 32) @ 750 g ha^{-1} (T_6) and pendimethalin 30 EC + imazethyper 2EC (Vallore 32)@ 1000 g ha^{-1} (T_7), imazethyper @ 40 g ha^{-1} (T_9) and imazethyper @ 55 g ha^{-1} (T_{10}).

At 60 DAS, the maximum leaf area index was registered under weed free plot (T_{11}) which was comparable to hand weeding twice at 20 and 40 DAS (T_2), pendimethalin 30EC + imazethapyr 2 EC (Vallore 32) @ 750 g ha^{-1} (T_6) and pendimethalin 30EC + imazethyper 2EC (Vallore 32) @1000 g ha^{-1} (T_7), imazethyper @ 25 g ha^{-1} (T_8) imazethyper @ 40 g ha^{-1}(T_9) and imazethyper @ 55 g ha^{-1} (T_{10}). This is in agreements with the finding of Idapuganti *et al*. (2005) [6] also reported that the highest LAI (4.96) were registered under weed free up to 60 DAS closely followed by twice hand weeding at 20 and 40 DAS.

Data reveals that the higher value of leaf area index reported under above stated treatments might be due to better control of weeds during critical period of crop-weed competition extended proper utilization of available moisture, nutrients, and space which turn may be responsible for better growth and development of plants. Our result fall in the line of results reported by Gowda (2007) [5] who stated that hand weeding twice at 20 and 40 DAS find maximum value leaf area index (3.67).

3.5. Number of branches plant^{-1}

Data recorded on number of branches plant^{-1} of urdbean at 20, 40, 60 DAS and at harvest as influenced by weed management practices are presented in Table 3. Results showed that number of branches plant^{-1} across all the stages of crop growth differed significantly due to weed management practices. The maximum number of branches plant^{-1} was recorded under weed free plot (T_{11}), at 20 DAS which was at par with the result obtained from plot treated with pendimethalin @ 1000 g ha^{-1} (T_3), quizalofop-ethyl @ 37.5 g ha^{-1} (T_4), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 750 g ha^{-1} (T_6) and pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1} (T_7). The lowest value of number of branches plant^{-1} was recorded under imazethapyr @ 55 g ha^{-1} (T_{10}).

Observations recorded at 40, 60 DAS and at harvest, indicates that the maximum number of branches plant^{-1} was observed under weed free plot (T_{11}), followed by results of hand weeding twice at 20 and 40 DAS (T_2), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 750 g ha^{-1} (T_6), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1}(T_7) and imazethapyr @ 40 g ha^{-1} (T_9) which were statistically at par. The significantly lowest number of branches plant^{-1} was observed under weedy check (T_1) at 40, 60 DAS and at harvest stage. The highest number of branches plan^{-1}t recorded under weed free plot (T_{11}) and chemical weed control measures might be due to the reduction in number of weeds and suppressive growth of remaining weeds provide optimum space, light, moisture and better utilization of available nutrient for proper growth and development of crops which turn in more number of branches plant^{-1}. These finding are close conformity with those of Yadav and Shrivastava (1998) [16]. reported weed free treatments and 1 hand weeding at 25 DAS find higher number of branches plant^{-1} (4.1 and 3.8). Banjara *et al*., (1999) [2] also reported higher number of branches plant^{-1} (14.7) under hand weeding twice at 20 and 40 DAS. Similar results have also been noted by Vyas and Kushwah (2008) [15]. and Vyas and Jain (2003) [14].

Table 3: Number of branches and Dry matter accumulation of urdbean as affected by weed management practices

Treatment	No. of branch plant^{-1}				Dry matter accumulation			
	20 Das	40 Das	60 Das	At harvest	20 Das	40 Das	60 Das	At harvest
T_1 Weedy check	1.73	2.27	4.00	4.80	1.53	2.70	3.90	6.82
T_2 Hand weeding twice	1.73	3.97	5.77	6.73	1.66	5.33	7.55	10.04
T_3Pendimethaln	1.90	2.60	4.60	5.47	1.82	3.25	6.00	7.68
T_4Quizalofop-p-ethyl	1.87	2.47	4.47	5.07	1.73	3.25	5.67	7.60
T_5Fenoxaprop-p-ethyl	1.80	2.37	4.40	5.00	1.53	3.00	4.96	7.00
T_6Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	1.93	3.50	5.07	6.00	1.88	4.22	7.00	9.35
T_7Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	2.00	3.60	5.27	6.33	1.90	4.71	7.14	9.42

T_8Imazethapyr	1.67	3.00	4.80	5.47	1.77	3.96	6.00	8.77
T_9Imazethapyr	1.67	3.93	5.73	6.53	1.73	4.73	7.31	9.64
T_{10}Imazethapyr	1.60	3.27	4.93	5.80	1.68	4.17	6.36	8.99
T_{11}Weed free plot	2.20	4.13	6.06	7.06	1.93	5.49	7.60	10.66
SEm±	0.11	0.21	0.34	0.37	0.09	0.30	0.55	0.82
CD (p=0.05)	0.32	0.63	1.01	1.10	0.26	0.88	1.60	2.40

3.6. Dry matter accumulation (g plant^{-1})

The data on dry matter accumulation of urdbean plant at various growth stages as influenced by weed management practices are presented in Table 3. Dry matter accumulation in urdbean plant showed significant variation due to weed management practices.

In general increasing trends of dry matter accumulation was noticed with the advancement of crop age under all treatments and it was maximum at harvest. At 20 DAS, the highest dry matter accumulation was recorded with weed free plot (T_{11}), which, was at par with the dry matter production obtained under the application of pendimethalin @ 1000 g ha^{-1} (T_3), quizalofop-ethyl @ 37.5 g ha^{-1} (T_4), pendimethalin 30 EC + imazethapyr 2 EC (T6), pendimethalin 30 EC + imazethapyr 2 EC @ (T7), imazethapyr @ 25 g ha^{-1} (T8), imazethapyr @ 40 g ha^{-1}(T9) and imazethapyr @ 55 g ha^{-1} (T10).

At 40 DAS, significantly maximum dry matter accumulation plant^{-1} was observed in weed free plot (T_{11}), however it was at par with that found under treatments of hand weeding twice at 20 and 40 DAS (T2), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1}(T7) and imazethapyr @ 40 g ha^{-1} (T_9).

At 60 DAS and at harvest, significantly maximum dry matter accumulation plant^{-1} was observed under weed free plot (T_{11}), and it was at par with, hand weeding twice at 20 and 40 DAS (T_2), pendimethalin @ 1000 g ha^{-1} (T_3) at 60 DAS, pendimethalin 30 EC + imazethapyr 2EC (Vallore 32) @ 750 g ha^{-1} (T_6), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1} imazethapyr @ 25 g ha^{-1} (T_8), imazethapyr @ 40 g ha^{-1}(T_9) and imazethapyr @ 55 g ha^{-1} (T_{10}) at both the stages. Whereas, least dry matter accumulation plant^{-1} was observed under weedy check (T_1) at all the periods of observation.

The plants grew under weed free situation and weed control with said herbicides accumulated significantly higher dry matter over control plot and trends was more or less similar during all the stages of observation. This might be due to better control of weeds enabled the crop plants to receive an optimum space, sufficient quantity of moisture, light and nutrients for their proper growth and development which in turn leads to maximum dry matter accumulation per unit area and time. The results are in agreements with the findings of Tiwari *et al*. (2006) [13]. who also observed that application of herbicides (pursuit @ 100 g a.i. ha^{-1} at 21 DAS) and weed free treatment (with 2 HW at 20 and 40 DAS) recorded significantly higher dry matter production plant^{-1} (16.30g and 16.96g) compared to weedy check. The lowest dry matter accumulation was associated with weedy check during all the stages of observations. It might be due to adverse effect of excessive crop-weed competition as expressed by maximum dry matter production of weed which resulted in reduction of nutrient uptake and dry matter accumulation by crop plants. Similar results have been reported by Deore *et al*., (2008) [4].

3.7. Number of nodules plant^{-1}

The data on the effect of various treatments on number of root nodules plant^{-1} recorded at 25 and 50 DAS are presented in Table 4.

Number of nodules plant^{-1} was significantly affected by weed management practices during both the stages of observation. In general the number of nodules was increased from 25 to 50 DAS. Significantly maximum number of root nodules plant^{-1} was counted under treatment weed free plot (T_{11}) at 25 DAS, which was comparable with the results of pendimethalin @ 1000 g ha^{-1} (T_3), pendimethalin 30 EC + imazethapyr 2EC (Vallore 32) @ 750 g ha^{-1} (T_6), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1}(T_7) and imazethapyr @ 55 g ha^{-1} (T_{10}).

While at 50 DAS, weed free plot (T_{11}) recorded significantly highest number of nodules plant^{-1} and result was at par the value obtained from hand weeding twice at 20 and 40 DAS (T_2), pendimethalin 30EC + imazethapyr 2EC (Vallore 32) @ 750 g ha^{-1} (T_6), pendimethalin 30 EC + imazethapyr 2EC (Vallore 32) @ 1000 g ha^{-1}(T_7) and imazethapyr @ 40 g ha^{-1} (T_{10}), whereas the minimum number of root nodule plan^{-1}t observed under weedy check plot during both observations.

The maximum number of root nodules plant^{-1} recorded in hand weeded as well as herbicide treated plots during both the stages of observation might be due to creation of favourable condition for crop growth owing due to optimum utilization of available moisture, nutrients, space and solar radiation for better growth of root and shoot which in turn helped in prolific nodulation in roots under aforesaid treatments. Raman *et al*. (2005) [10] also found that hand weeding at 20 and 40 DAS resulted more nodule number of nodules (31) plant^{-1} followed by pre-emergence application of pendimethalin @ 1.0 kg ha^{-1} + hand weeding at 20 DAS having 28 nodule number plan^{-1}t in urdbean crop.

Table 4: Number of nodules and Dry weight of nodules (mg plant^{-1}) in urdbean as affected weed management practices.

	Number of nodules		Dry weight of nodules (mg plant^{-1})	
Treatment	**25 Das**	**50 Das**	**25 Das**	**50 Das**
T_1 Weedy check	23.67	33.60	12.03	21.67
T_2 Hand weeding twice	24.73	41.73	15.27	30.93
T_3Pendimethaln	26.00	35.60	16.00	26.60
T_4Quizalofop-p-ethyl	23.67	34.13	13.73	24.53
T_5Fenoxaprop-p-ethyl	22.67	34.00	12.73	25.13
T_6Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	26.73	38.07	15.33	29.20
T_7Pendimethalin 30EC +Imazethapyr 2EC (Vallore 32)	27.07	39.67	16.33	29.47
T_8Imazethapyr	24.47	35.53	13.40	27.27
T_9Imazethapyr	24.60	41.27	14.80	30.40
T_{10}Imazethapyr	26.00	36.73	13.93	28.71
T_{11}Weed free plot	29.10	44.27	16.73	31.63

SEm±	1.19	2.18	0.98	1.69
CD (p=0.05)	3.50	6.43	2.88	4.96

3.8. Dry weight of nodules (mg plant^{-1})

Dry weight of nodules plant^{-1} of urdbean was recorded at 25 and 50 DAS and data are presented Table 4. The effect of various treatments on the dry weight of nodules was significant. At 25 DAS, significantly higher dry weight of nodules plant^{-1} was recorded from the weed free plot (T_{11}), followed by hand weeding twice at 20 and 40 DAS (T_2), pendimethalin @ 1000 g ha^{-1} (T_3), pendimethalin 30 EC + imazethapyr 2EC (Vallore 32) @ 750 g ha^{-1} (T_6), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1} (T_7), imazethapyr @ 40 g ha^{-1}(T_9) and imazethapyr @ 55 g ha^{-1} (T_{10}) which were statically on par. The trend was similar at 50 DAS also and significantly maximum dry weight of nodules plan^{-1}t was observed under weed free plot (T_{11}), which was comparable with the results received from hand weeded plot at 20 and 40 DAS (T_2), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 750 g ha^{-1} (T_6), pendimethalin 30 EC + imazethapyr 2 EC (Vallore 32) @ 1000 g ha^{-1} (T_7), imazethapyr @ 25 g ha^{-1} (T_8), imazethapyr @ 40 g ha^{-1}(T_9) and imazethapyr @ 55 g ha^{-1} (T_{10}). The lowest dry weight of nodules was recorded in weedy check during both the stages of observation.

Increased dry weight of nodules plant^{-1} in hand weeded as well as herbicide treated plot might be due to better control of weeds, creates congenial environment for proper root and shoot growth which turn in increased number of healthy nodules in plants which leads to higher value of dry weight of nodules during both the stages of observation. Similar results were also reported by Raman *et al*. (2005) [11]. who reported hand weeding treatment at 20 and 40 DAS resulted higher nodule dry weight of 4.98 g plant^{-1} followed by pre emergence application of pendimethalin @ 1.0 kg ha^{-1} + hand weeding at 20 DAS having nodule dry weight of 3.84 g plant^{-1} in urdbean crop. Lowest dry weight of nodules was observed under weedy check (T_1) might be due to more crop-weed competition resulted poor root shoot growth. Lower number of nodules leads to lowest dry weight.

4. Conclusion

Although the highest yield attributes and seed yield of urdbean was recorded under hand weeding twice performed at 20 and 40 DAS but they were similar to post emergence application of Imazethapyr 40 g ha^{-1}. Similarly minimum density and dry matter production of weeds and maximum weed control efficiency (60.22 % and 51.34 % respectively) was also achieved under these treatments. According to economic feasibility of these treatments maximum benefit: cost ratio was obtained with post emergence application of Imazethapyr 40 g ha^{-1} (1.33) followed by hand weeding twice (1.20) and net income of Rs. 19609.90 and Rs. 20253.60 respectively. Therefore, post emergence application of Imazethapyr 40 g ha^{-1} could be a good alternative to suppress weeds compared to manual weeding.

5. References

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