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INTEGRATED EFFECT OF SEEDING RATES AND WEED MANAGEMENT REGIMES ON WEED DYNAMICS, CROP PERFORMANCE AND PRODUCTION POTENTIAL OF URDBEAN (*Vigna mungo* L. Hepper) IN *ALLUVIAL* PLAIN ZONE OF INDIA

YADAV AJAY[1], DWIVEDI ASHISH[1*], SINGH RAGHUVIR[1], SINGH ADESH[1], KISHORE ROOP[2] AND CHAUDHARY RAHUL[1]

[1]Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, U.P., 250110, India
[2]Department of Agronomy, Doon (P.G.) College of Agric. Science & Technology, HNB Garhwal University, Deharadun - 248 001, Uttrakhand, India
*Corresponding Author: Email: ashishdwivedi842@gmail.com

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Abstract- Weeds cause stern concern on yield diminution in legumes worldwide. Losses caused by weeds vary from one country to other country, depending on the being there of leading weed flora and control methods adopted by farmers, consequently a field experiment was conducted in urdbean during *Kharif* season of 2013 in subtropical zone to investigate integrated effect of seeding rates and weed management regimes on weed dynamics, crop performance and production potential in Alluvial plain zone of India. The results disclosed that 15 kg seed rate ha-1 measured highest growth attributes at harvest *viz*., dry weight, number of branches, and 1000 grain weight, while tallest plant at harvest was measured in the treatments where 25 kg ha-1 seed rate was applied, besides suppressed the density and their dry weight of *Echinochloa colona*, *Cyperus rotundus*, *Trianthema monogyna* and other weeds than the other treatments. Moreover, 15 kg seed rate ha-1 produced significantly higher grain yield (1329 kg ha-1). Furthermore, highest N, P and K content of urdbean in grain and straw and weeds were also observed in 15 kg seed rate ha-1 over 20 and 25 kg seed rate ha-1. Likewise, in weed management practices, both mechanical and chemical method of weed management was found superior over weedy check to achieve more above parameters. Among the herbicidal treatment Pendimethalin @ 1.0 kg a.i ha-1 PE + one hand weeding was shown its superior in respect to above values of performance and weeds as compared to their counterparts. Thus 15 kg seed rate ha-1 combination with Pendimethalin @ 1.0 kg a.i ha-1 as Pre-emergence + one hand weeding at 40 DAS may be suggested for effectively control of weeds in urdbean and also for obtaining maximum economical grain yield, net return, and benefit: cost ratio of urdbean crop.

Keywords: Seed Rates, Weed Management Regimes, Weed Dynamics, Crop Performance, Production Potential and Urdbean

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Introduction

India and Central Asia are considered as the primary and secondary centre of origin of black gram, respectively. The distribution of black gram is comparatively restricted to tropical regions. The total area under pulse crop in India is 23.47 mha, production 18.34 m tonnes with the productivity of 650 kg ha^{-1}. Out of total pulse area, the Urdbean occupies an area of 8.22 mha and production is 7.24 m tonnes with the productivity of 881 kg ha^{-1}. The major Urdbean growing states in India are Orissa, Maharashtra, Andhra Pradesh, Rajasthan, Karnataka, Gujarat, Tamil Nadu, Madhya Pradesh, Uttar Pradesh and Punjab. Orissa ranks first in area and production and Punjab is the leading state in productivity. During 2012-13, the area, production and productivity of Urdbean in Uttar Pradesh were 5.46 lakh ha, 3.65 lakh tonnes and 595 kg ha^{-1}, respectively [1]. Pulse crops have certain unique features, which together make them indispensable for human diet. Firstly, pulse crop play an important role in the agricultural economy of India by virtue of their ability to fix atmospheric nitrogen [2].

The optimum seed rate varies with germination percentage of the seed material. Seed rate is also one of the most important factors responsible for maximizing yield of black gram, change in seed rate within a certain limits, result in change in productivity. Seed rate becomes more important for yield governing factors like moisture, light and plant nutrients with each other [3].

Weeds are the cause of serious problem on yield reduction worldwide. Losses caused by weeds vary from one country to other country, depending on the presence of predominant weed flora and on the control methods practiced by farmers [4]. Although, among different limitation in urdbean production, weed problem particularly in *kharif* season is a major one in which conventional methods of weeds controlling no doubt, accomplish the job effectively but they are time taking, tedious and expensive. Furthermore, there is a lack of availability of manual labour in peak season for timely control of weeds. Moreover, now a day number of herbicides are available in the market, which controls the weeds in urdbean rather effectively. The controlling of weeds with herbicides in the growing crops increases their yields and ensures the efficient use of water, fertilizer and protection measures.

Being a cheap source of vegetarian protein for direct human consumption, it is also known as “poor man’s meat”. In spite of being widely adopted crop, it’s per hectare yield is very low, this might be due to poor fertility status of soil. Therefore, fertility management is imperative to ensure better crop production on exhausted soil [5]. Imbalance in growth of human population and pulse production had led to lowering of the availability of pulses from 69 g/ person / day in 1960-61 to 37 g per person per day in 1995 and 35 g per person per day in 2004 as against the "World Health organization" standard normally 80 g/ person /day. Thus, there is a wide gap between production and demand of pulses in the country to make up this shortfall in supply besides further demand from burgeoning population at least 23.90 m tones of pulses are required by 2015 which is expected to touch 29.31 m tonnes by 2020 A.D. to meet out the requirement of pulses [6]. Because of this, farmers have chosen to grow pulse crop under highly diversified conditions. In general, they are more drought resistant than any other cereal crop. Among the controllable component of environment, the establishment of adequate plant population is important one.

Integration of pendimethalin 30 EC at 0.75 kg ha^{-1} as pre-emergence with one hand weeding at 40 DAS showed superiority with regard to weed management over other treatments, besides producing maximum grain yield [7]. Though, a seed rate of 20 kg ha^{-1} produced the maximum number of the branches/ plant & number pod/ plant, number of seed/ pod and 1000-seed weight during the first and second seasons [8]. Moreover, an increase of 27.4 to 31.0% in grain yield was recorded application of 20 kg seed/ha produced the highest grain yield, which was significantly higher than other seed rate [9]. Furthermore, an increasing the seed rate, weed growth can be declined. Uncontrolled weeds caused 80% reduction in grain yield of urdbean as compared to pendimethalin @ 1.5 kgha^{-1}+ HW 40 DAS, which produced the maximum yield [10]. However, none of the weed control treatments could significantly influence N and P contents in mungbean. However, the weedy control treatment had the maximum uptake of N and P by weeds. Pendimethalin at 1.0 kg ha^{-1} + hand weeding at 30 DAS resulted in significantly lower N and P uptake by weeds as compared to its alone application and other herbicidal treatments [11]. Whereas, higher N content under two hand weedings at 20 and 30 DAS while P content in mungbean was not influenced by weed control treatments. P-uptake in crop was recorded higher in the treatment of acetachlor at 0.75 kg ha^{-1} + hand weeding at 35 DAS [12]. As a result, the present study was carried out to investigate effect of seeding rate and weed management regimes on performance, vis-à-vis productivity and their significant interaction of black gram.

Materials and methods

A field experiment was conducted during *Kharif* season 2013 at Crop Research Centre (Chirauri) of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), located at a latitude of 29^0 40' North and longitude of 77^0 42' East with an elevation of 237 metres above mean sea level, the mean annual rainfall was about 630 mm [Fig-1]. The area lies in the heart of Western Uttar Pradesh.

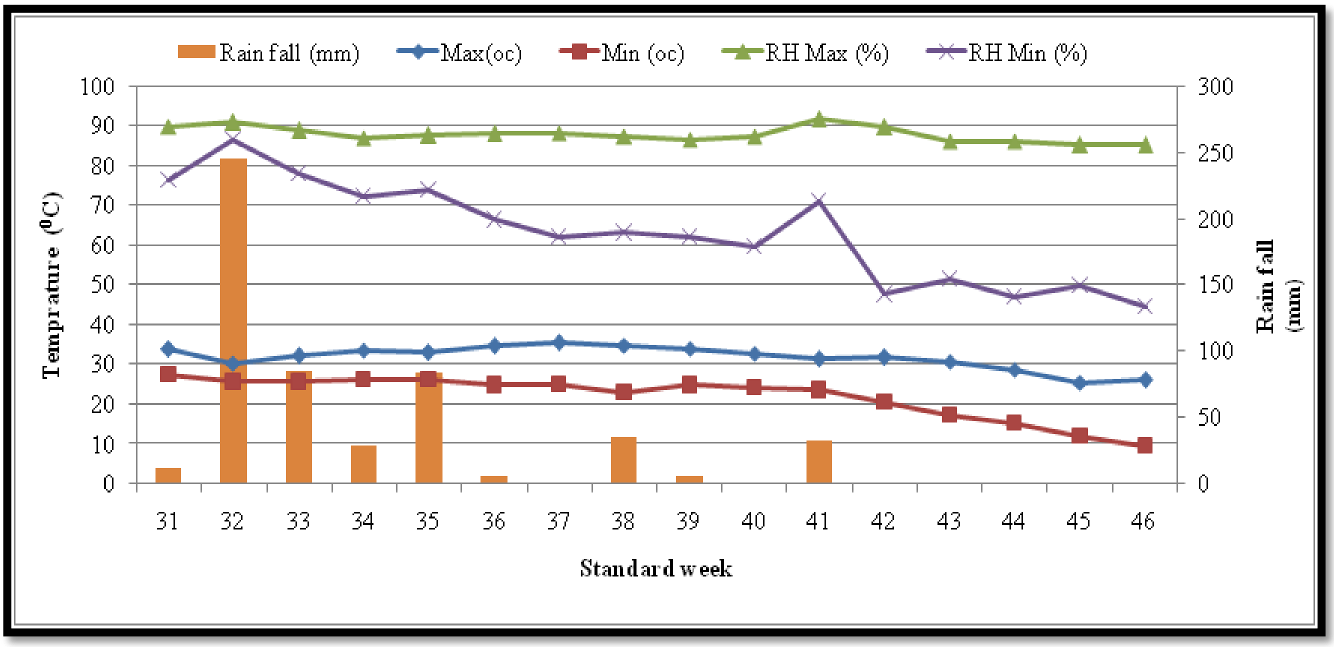

Fig-1 The meteorological data were recorded during the experimentation period (July to November 2013).

The experimental field was well drained, sandy loam in texture and slightly alkaline in reaction (pH 7.80), It was medium in organic carbon (0.520 %), available nitrogen (220.60 kg/ha) and available phosphorus (16.10 kg/ha) but high in available potassium (242.0 kg/ha) with an electrical conductivity (1:2, soil: water suspension) and a bulk density of 1.60 dS/m and 1.25 Mg/m^3, respectively. In this investigation two-factor studies was planned. In first factor, three seeding rates i.e. 15, 20 and 30 kg ha^{-1} and the second factor, six weed management practices i.e. weedy check, two hand weedings at 20 and 40 DAS, fluchloralin @ 1.0 kg ha-1 PPI, fluchloralin @ 1.0 kg a.i. ha-1 PPI + one HW at 40 DAS, Pendimethalin @ 1.0 kg ha^{-1} PE, Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one HW at 40 DAS, were tested in randomized block design with three replication by using "*F*" test. The herbicides were applied by using knap sap sprayer. The gross plot size was 15 m^{-2} and 50 cm buffer area was maintained between two plots within the replication, while the block border size was 0.75 meter Varieties Type 9 grown with recommended agronomic package. The seeds were placed manually in the furrows at a varying plant-to-plant distance with a 15, 20 and 25 kg ha^{-1} seed rate as per the treatments, sown on 13 August 2013, and harvested 5 November 2013. A uniform dose of 100 kg ha^{-1} Di-ammonium phosphate (18: 46: 0, NPK) was applied at the time of sowing as basal application in furrows. Only one irrigation was applied. The weed population at maturity comprises *Echinochola colona, Cyperus rotundus, Trianthema monogyna* and otherweeds with their dry weight, whereas plant height, dry weight and number of branches were measured at harvest, 1000-grain weight and yields of the crop were recorded.

Plant sampling and analysis

Analysis of plant sample at harvest was carried out for their nitrogen, phosphorus and potassium contents in grain and straw for urdbean and plants for weeds by adopting the standard procedures as described by Page [13]. The samples were dried at 70 °C in a hot air oven. The dried samples were ground in a stainless steel Thomas Model 4 Wiley ® Mill. The N content in plant was determined by digesting the samples in sulfuric acid (H_2SO_4), followed by analysis of total N by the Kjeldahl method Page[13] using a Kjeltec™ 8000 auto analyzer (FOSS Company, Denmark). The P content in plant was determined by the vanadomolybdo-phosphoric yellow colour method and the K content was analyzed in di-acid (HNO_3 and $HClO_4$) digests by the flame photometric method Page [13].

Weed studies

Weeds from experimental site were collected, identified and classified as broad leaf weeds, grassy and sedges. The weed species recorded in experimental field were *Echinochloa colona, Trianthema monogyna, Cyperus rotundus, Eleusine indica, Commelina benghalensis, Cyndodon dactylon, Digitaria sanguinalis, Celosia argentia, Amaranthus viridis,* etc., Out of 9 weed species, three major weeds are classified as *Cyperus rotundus* among sedges, *Echinochola colona among grassy* and *Trianthema monogyna* in broad leaved weeds were found [Table-1].

Statistical analysis

The data recorded on different observations were tabulated and analyzed statistically by using the analysis of variance (ANOVA) techniques as suggested by Gomez and Gomez [14]. Moreover, production economics were computed as per standard methods.

Table-1 *Common weeds associated with urdbean crop.*

Scientific name	English or common name	Local name	Family
I. Grassy weeds			
Echinochloa colona (L) Link	Jungle rice	Samak	Poaceae
Cynodon dactylon (L).	Bermuda grass	Doob	Poaceae
Eleusine indica (L)	Goose grass	Mandua	Poaceae
Digitaria sanguinalis (L) Scop	Large crab grass	-	Poaceae
II. Non - grassy weeds			
Trianthema monogyna (L)	Carpet weed	Patharchatta	Aizoaceae
Celosia argentia (L)	White cock's comb	Safed murga	Amaranthaceae
Commelina benghalensis (L)	Day flower	Kancova	Commelinaceae
Amaranthus viridis (L)	Pigweed	Cholai	Amaranthaceae
III. Sedges			
Cyperus rotundus (L)	Purple nut sedge	Motha	Cyperaceae

Results and discussion

Density and dry weight of weed at harvest

The data provided in [Table-2 and 3] showed that seed rates brought significant effect on density and dry weight of weed at harvest stage of crop. Moreover, increasing the seed rates per hectare from 15 to 25 kg ha^{-1} decreased significantly density and dry weight of *Echinochloa colona*, *Cyperus rotundus*, *Trianthema monogyna* and other weeds at harvest stages. However, higher seed rates of 25 kg ha^{-1} recorded minimum density and dry weight of *Echinochloa colona*, *Cyperus rotundus*, *Trianthema monogyna* and other weeds which were 3.16, 3.26, 2.94 and 2.58 no. m^{-2}, respectively for weed density and 2.15, 2.21, 2.03 and 1.82 g m^{-2}, respectively for weed dry weight**.** The reduction in *Echinochloa colona*, *Cyperus rotundus*, *Trianthema monogyna* and other weeds and less dry matter production of them may be due to an appreciable smoothing effect on weed as 25 kg seed rate ha^{-1} leaving very little space for weed to grow. Moreover, better crop weed competition in favour of crop resulting higher grain yield of urdbean with 15 kg seed rate ha^{-1} as compared to 20 and 25 kg seed rates ha^{-1}, respectively. These results are supported by the observation of Choudhary *et al.*,[15], Jan *et al*., [16] and Fida *et al.,* [17].

Among the various treatments, two hand weeding noticed significantly minimum density (1.73, 1.70, 1.79 and 1.81 no. m^{-2}) and their dry weight (1.35, 1.33, 1.37 and 1.39 g m^{-2}) of *Echinochloa colona*, *Cyperus rotundus*, *Trianthema monogyna* and otherweeds, respectively at harvest stages over rest of its counterparts. Density and dry weight of weed were remained statistically *on par* with Pendimethalin @ 1.0 kg a.i. ha^{-1} PE + one HW for all species, although Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI + one HW at 40 DAS was also alike withdensity of weed for *Trianthema monogyna* and other weeds population only, whereas *Echinochloa colona*, besides *Trianthema monogyna* and other weeds for dry weight of weeds. Moreover, maximum density and dry weight of weeds at harvest stage of crop was found under treatment weedy check in all species including other weeds. It may be due to effective control of weed by hand pulling, besides minimizing less weed population throughout the crop growth resulting substantial reduction in *Echinochloa colona*, *Cyperus rotundus*, *Trianthema monogyna* and other weeds and subsequently their dry weight at harvest. These finding are supported by the results of Ramanathan and Chandrashakharan [18] and Rameshchand *et al.,* [19].

Interaction of density and dry weight of *Cyperus rotundus*

The data presented in [Table-4] indicates that the interaction effect between seed rates and weed management practices was found significant on density and dry weight of *Cyperus rotundus* at harvest. The lowest weed population (1.41 m^{-2}) and weed dry weight (114 g m^{-2}) of *Cyperus rotundus* was found under treatment combination 25 kg seed rate ha^{-1} with two hand weeding, and the highest weed population and weed dry weight (10.39 m^{-2} and 6.52 g m^{-2}) was found under 15 kg seed rate ha^{-1} in weedy check plot.

Table-2 *Effect of seeding rate and weed management regimes on different weed flora*

Treatments		*Echinochloa colona*	*Cyperus rotundus*	*Trianthema monogyna*	Other weeds
Seeding Rates (kg ha^{-1})					
S_1-	15	4.33 (19)	4.53 (21)	4.28 (18)	3.39 (11)
S_2-	20	3.79 (14)	3.90 (15)	3.57 (13)	2.98 (9)
S_3-	25	3.16 (10)	3.26 (11)	2.94 (9)	2.58 (7)
	SEm ±	0.07	0.08	0.11	0.09
	CD.(P=0.05)	0.21	0.25	0.33	0.28
Weed Management Practices					
W_1-	Weedy check	7.71 (59)	9.46 (89)	8.60 (74)	5.58 (31)
W_2-	Two hand weeding at 20 and 40 DAS	1.73 (3)	1.70 (3)	1.79 (3)	1.81 (3)
W_3-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI	5.05 (25)	4.07 (17)	4.04 (16)	3.65 (13)
W_4-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI + one HW at 40 DAS	2.11 (4)	2.18 (5)	1.84 (3)	1.99 (4)
W_5-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE	4.02 (16)	4.04 (16)	3.65 (13)	3.05 (9)
W_6-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one HW at 40 DAS	1.96 (4)	1.93 (4)	1.75 (3)	1.83 (3)
	SEm ±	0.10	0.12	0.16	0.13
	CD(P=0.05)	0.30	0.36	0.45	0.40

Table-3 *Effect of seeding rate and weed management regimes on dry weight of weed flora*

Treatments		*Echinochloa colona*	*Cyperus rotundus*	*Trianthema monogyna*	Other weeds
Seeding Rates (kg ha^{-1})					
S_1-	15	2.87	2.99	2.83	2.29
S_2-	20	2.53	2.60	2.40	2.04
S_3-	25	2.15	2.21	2.03	1.82
	SEm ±	0.04	0.05	0.06	0.05
	CD.(P=0.05)	0.13	0.15	0.19	0.16
Weed Management Practices					
W_1-	Weedy check	4.83	5.91	5.38	3.55
W_2-	Two hand weeding at 20 and 40 DAS	1.35	1.33	1.37	1.39
W_3-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI	3.22	2.64	2.61	2.38
W_4-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI + one HW at 40 DAS	1.53	1.59	1.41	1.48
W_5-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE	2.65	2.66	2.37	2.09
W_6-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one HW at 40 DAS	1.51	1.48	1.39	1.40
	SEm ±	0.06	0.07	0.09	0.08
	CD(P=0.05)	0.19	0.22	0.27	0.25

Table-4 *Interaction effects of seeding rates and weed management regimes on Cyperus rotundus weeds at harves*

Weed Management Practices	Weed density (m^{-2})				Weed dry weight (g m^{-2})			
	Seeding Rates (kg ha^{-1})							
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
W_1	10.39	9.43	8.55	9.46	6.52	5.89	5.32	5.91
W_2	1.98	1.71	1.41	1.70	1.49	1.35	1.14	1.33
W_3	4.95	4.08	3.17	4.07	3.20	2.64	2.09	2.64
W_4	2.62	2.27	1.65	2.18	1.84	1.63	1.31	1.59
W_5	5.02	4.03	3.06	4.04	3.28	2.64	2.05	2.66
W_6	2.20	1.88	1.71	1.93	1.63	1.44	1.36	1.48
Mean	4.53	3.90	3.26		2.99	2.60	2.21	
SEm ±	0.21				0.13			
C.D.(P=0.05)	0.63				0.38			

Table-5 Effect of seeding rate and weed management regimes on growth attributes at harvest, 1000 grain weight, yields and nutrients content in weed

	Treatments	Plant height (cm)	Dry weight (g $plant^{-1}$)	Branches $plant^{-1}$	1000 Grain wt.(g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	N Content in weed (%)	P Content in weed (%)	K Content in weed (%)
	Seeding Rates(kg ha^{-1})									
S_1-	15	51.60	24.67	10.00	34.76	1329	2596	0.97	0.25	0.78
S_2-	20	52.67	23.09	8.50	32.51	1196	2344	0.95	0.24	0.76
S_3-	25	54.64	21.99	7.33	30.91	1068	2196	0.94	0.23	0.74
	SEm ±	0.43	0.05	0.15	0.17	8.00	14.00	0.002	0.001	0.001
	CD.(P=0.05)	1.25	0.16	0.43	0.51	24.00	41.00	0.006	NS	0.004
	Weed Management Practices									
W_1-	Weedy check	48.20	17.73	6.33	29.61	716	1938	0.95	0.24	0.93
W_2-	Two hand weeding at 20 and 40 DAS	59.84	26.75	10.33	35.00	1461	2867	0.98	0.23	0.84
W_3-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI	51.82	22.53	8.00	31.57	1089	2286	0.93	0.24	0.86
W_4-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI + one HW at 40 DAS	54.75	24.60	9.00	32.43	1340	2408	0.96	0.24	0.81
W_5-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE	50.71	22.31	8.33	33.39	11.64	2293	0.96	0.24	0.71
W_6-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one HW at 40 DAS	51.84	25.58	9.66	34.36	1416	2462	0.97	0.24	0.81
	SEm ±	0.61	0.08	0.21	0.252	13.00	20.00	0.003	0.002	0.002
	CD(P=0.05)	1.76	0.23	0.61	0.728	39.00	58.00	0.008	NS	0.006

Growth attributes

An increment of seed 5 kg ha^{-1} successive from 15 to 25 kg ha^{-1} brought significant differences growth parameters at stages [Table-5]. However, 25 kg ha^{-1} showed its superiority to achieved tallest plant (54.64 cm) as compared to rest of its level. However, 15 kg seed rate ha^{-1} measured shortest plant and maximum dry weight (24.67 g) and number of branches $plant^{-1}$ (10.00). This may be because of higher struggle for interception and utilization of light in closer spacing resulted tallest plant. Moreover, as far as the number of branches and dry weight was concern, it clearly stated that branches and dry weight decrease with increased in seeding rate resulted maximum photosynthetic. These results were in conformity with the finding of Rathore *et al.*,[3] and Yadav *et al*,.[9].

Among the weed management, two hand weeding measured significantly tallest plant (59.84 cm), accumulates higher dry weight (26.75 g) and number of branches (10.33) at harvest. Among the herbicidal treatment, Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI + one HW at 40 DAS was shown superiority to achieved tallest plant as compared to their rest of the treatment, whereas Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one HW at 40 DAS recorded higher dry weight and number of branches at harvest. Although, lower values of above parameters were measured under weedy check. This might be due to the more competition of crop with weeds for light, water; nutrients and CO_2 under weedy check plots and efficient uprooted of weeds by hand weedings. These finding are in conformity with the findings of Rameshchand *et al.* [19].

Yield attribute and yields

Data related to yields and its attributes presented in [Table-5] revealed that 1000 grain weight (34.76 g), grain yield(1329 kg ha^{-1}) and straw yield (2596 kg ha^{-1}) were noticed significantly higher under 15 kg seed rate ha^{-1} than the other treatments. Furthermore, on an average 24.43 and 11.12 % more grain yield was found with using 15 kg seed rate ha^{-1} over 25 and 20 kg seed rate ha^{-1}, respectively. Significantly minimum 1000-grain weight and yields were recorded with 25 kg seed rate ha^{-1}. Increase in yield might be due to higher dry matteraccumulation and also more translocation of photosynthates toward sink which resulted more growth and yield attributes by optimum space. Similar findings were also reported by Sekhon *et al.,*[20] and Yadav *et al.*[9].

Like in above, weed management practices had also brought a significant variation on 1000-grain weight and yields. The highest 1000 grain weight (35.00 g) and grain yield (1461 kg ha^{-1}) of crop was recorded under two hand weeding at 20 and 40 DAS, which was statistically *on par* with Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one HW at 40 DAS. Moreover, W_2 showed superiority to obtained maximum in terms of straw yield (2867 kg ha^{-1}). Weedy check noticed lower yields and test weight.It mainly due to fact that weed control at earlystage of cropgrowth by two consecutive hand weeding and minimizing the weed population up to critical stages to prevent emergence of late coming weed. These finding are supported by the results of Shweta [10] and Gupta *et al*. [21].

Nutrients content in weeds

Among the seed rate significantly highest nutrientscontent in weed *viz.,* nitrogen (0.97 %), phosphorus (0.25 %) and potassium (0.78 %) were measured under 15 kg seed rate ha^{-1} (0.97%) [Table-5], which was significantly higher than rest of the seed rate treatments. however phosphorus was not significant. Although, lowest nitrogen, phosphorus and potassium content in weeds was recorded with 25 kg seed rate ha^{-1}, which was 0.94, 0.23 and 0.74 %, respectively. The nutrient content was directly related to root growth in terms of number and dry weight of root nodules per plant, which will be more at low population density. These findings were in conformity with the results of Rathore *et al.* [3] and Yadav *et al.* [9].

Apart from above, weedy check measured significantly maximum potassium content in weed (0.93 %), while it also shown statistical alike variation in phosphorus in which all treatments shown a similar values of phosphorus (0.24 %), except two hand weeding where nitrogen content (0.98%) was maximum. The content of phosphorus and potassium in weed was higher due to more availability of these nutrients under weed dominant condition, whereas two hand weeding create aeration which out yield better nodulation consequently nitrogen availability will increase which feed the nutrient from soil, therefore nitrogen content was increased in two hand weeding. The similar opinions were also put forward by Choubey *et al*. [22].

Interaction on plant height and dry matter accumulation

The data presented in [Table-6] indicates that the interaction effect between seed rates and weed management practices on plant height and dry matter accumulation was measured significant at 60 DAS. The highest plant height (57.31 cm) was found under treatment combination 25 kg seed rate ha^{-1} with two hand weeding, whereas maximum dry weight was measured 15 kg seed rate ha^{-1} with two hand weeding (23.81 g $plant^{-1}$) highest plant height was subsequently followed by treatment combination of 25 kg seed rate ha^{-1} with Pendimethalin @ 1.0 kg a.i. ha^{-1} PE + one HW and the lowest plant height (41.26 cm) was found under 15 kg seed rate ha^{-1} in weedy check. The lowest plant dry matter was found under 25 kg seed rate ha^{-1} with weedy cheek plot (13.71 g $plant^{-1}$).

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Table-6 *Interaction effects of seeding rates and weed management regimes on plant height, dry weight of plant and nodules dry weight*

Weed Management Practices	Plant height (cm) at 60 DAS				Dry weight of plant (g/plant) at 60 DAS				Dry weight of root nodules (mg/plant) at 45 DAS			
	Seeding Rates (kg ha^{-1})											
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
W_1	41.26	42.21	44.25	42.57	16.73	14.72	13.71	15.05	47.51	43.69	39.58	43.59
W_2	54.31	55.46	57.31	55.69	23.81	22.60	21.40	22.60	86.99	82.41	77.56	82.32
W_3	46.86	47.91	49.92	48.23	20.89	19.69	18.48	19.69	71.58	66.43	64.36	67.45
W_4	48.54	49.63	51.85	50.01	21.84	20.81	19.76	20.80	73.59	67.38	65.86	68.94
W_5	43.61	44.53	46.83	44.99	21.06	19.04	22.63	20.91	69.53	66.83	65.31	67.22
W_6	47.54	48.38	49.36	48.42	21.50	21.50	20.38	21.13	71.48	67.32	65.20	68.00
Mean	47.02	48.02	49.92		20.97	19.72	19.39		70.11	65.68	62.97	
SEm ±	0.68				0.26				1.17			
C.D.(P=0.05)	2.01				0.77				3.48			

Interaction on plant root nodules

The data presented in [Table-6] indicates that interaction effect between seed rates and weed management practices on nodules dry weight was significant at 45 DAS. The highest nodules dry matter was found under treatment combination 15 kg seed rate ha^{-1} with two hand weeding (86.99 mg). The lowest plant root nodules were found under 25 kg seed rate ha^{-1} with weedy cheek (39.58 mg)

Interaction on test weight and straw yield

The data prevailed in [Table-7] revealed that the interaction effect between seed rates and weed management practices on test weight and straw yield was significant. The highest test weight (37.22 g) and straw yield (30.56 q ha $^{-1}$) was found under treatment combination of 15 kg seed rate ha^{-1} with two hand weeding. The lowest test weight and straw yield was found under 25 kg seed rate ha^{-1} under weedy check treatment (27.58 g) and (16.98 q ha $^{-1}$), respectively.

Nutrients content in crop

Using the 15 kg seed rate ha^{-1} were significantly recorded higher nitrogen (3.66 and 1.53 %), phosphorus (0.60 and 0.24 %) and potassium content (0.63 and 1.68 %) in grain and straw, except phosphorus content in grain and straw both which showed not significant differences among themselves [Table-8]. Although, lowest nitrogen, phosphorus and potassium content in grain and straw was recorded with 25 kg seed rate ha^{-1}. This might be due to the fact that dry matter increased in terms of grain and straw yields and better weed control. These findings confirm the results of Rathore *et al.* [3]

Table-7 Interaction effects of seeding rates and weed management regimes on 1000 grain weight and straw yield

Weed Management Practices	1000 grain weight (g)				Straw yield (q ha^{-1})			
	Seeding Rates (kg ha^{-1})							
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
W_1	32.18	29.09	27.58	29.61	22.63	18.54	16.98	19.38
W_2	37.22	34.59	33.19	35.00	30.56	28.34	27.12	28.67
W_3	33.71	31.25	29.75	31.57	24.67	22.56	21.36	22.86
W_4	34.54	32.36	30.40	32.43	26.73	23.64	21.87	24.08
W_5	34.59	33.68	31.90	33.39	24.67	22.68	21.45	22.93
W_6	36.35	34.08	32.66	34.36	26.54	24.34	22.98	24.62
Mean	34.76	32.51	30.91		25.96	23.44	21.96	
SEm ±	0.42				0.34			
C.D.(P=0.05)	1.24				1.00			

Table-8 Effect of seeding rate and weed management regimes on nutrient content in Urdbean

Treatments		N Content (%)		P Content (%)		K Content (%)	
Seeding Rates (kg ha^{-1})		Grain	Straw	Grain	Straw	Grain	Straw
S_1-	15	3.66	1.53	0.60	0.24	0.63	1.68
S_2-	20	3.64	1.51	059	0.24	0.62	1.66
S_3-	25	3.62	1.48	0.59	0.23	0.61	1.63
	SEm ±	0.004	0.003	0.002	0.001	0.002	1.01
	CD.(P=0.05)	0.012	0.007	NS	NS	0.005	0.03
Weed Management Practices							
W_1-	Weedy check	3.59	1.42	0.58	0.22	0.57	1.60
W_2-	Two hand weeding at 20 and 40 DAS	3.66	1.55	0.61	0.25	0.63	1.67
W_3-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI	3.65	1.52	0.59	0.23	0.62	1.68
W_4-	Fluchloralin @ 1.0 kg a.i. ha^{-1} PPI + one HW at 40 DAS	3.64	1.53	0.60	0.24	0.63	1.66
W_5-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE	3.64	1.52	0.60	0.23	0.64	1.69
W_6-	Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one HW at 40 DAS	3.65	1.52	0.61	0.25	0.63	1.67
	SEm ±	0.006	0.004	0.003	0.002	0.002	0.01
	CD(P=0.05)	0.018	0.010	0.009	NS	0.007	0.04

Unlikely agronomic practice bring significant variation in nitrogen, phosphorus and potassium content in grain and nitrogen and potassium content in straw, in which it had recorded maximum nitrogen (3.66 and 1.55%) and phosphorus (0.61 and 0.25%) in grain and straw, while potassium content in grain (0.64 %) and straw (1.69 %) was higher under spraying of Pendimethalin @ 1.0 kg a.i ha^{-1} PE. Though, lowest nitrogen, phosphorus and potassium content in grain and straw were recorded under weedy check. Weed usually absorbs mineral nutrients faster than many of our crop plants and accumulates them in their tissues in relatively larger amounts. Competition depends upon type and density of weed flora associated with the crop. Generally, morphologically similar weeds are more competitive than dissimilar weeds and depending upon their intensity and type of crop, these weeds can trap 30% to 60% of the applied nutrients due to their quick growing habits. Therefore, it will depress the nutrient accumulation in the crop. The similar findings were also reported by Choubey *et al.* [22], Singh and Saha [23] and Kumar *et al.* [11].

Conclusion

Based on the above findings of one year experimentation, it can be conclude that sowing of 15 kg seed rate ha^{-1} proves its superiority over 20 and 25 kg seed rates ha^{-1} by producing higher grain yield along with two hand weedings, beside suppress the weed flora and their dry weight. Moreover, Pendimethalin @ 1.0 kg a.i ha^{-1} PE + one hand weeding recorded maximum grain yield and all parameter of crop growth at harvest, nutrient content and minimum weeds. Thus 15 kg seed rate ha^{-1} combination with Pendimethalin @ 1.0 kg a.i ha^{-1} Pre-emergence + one hand weeding at 40 DAS at 25 cm apart may be suggested for effectively control of weeds in urdbean and also for obtaining maximum economical grain yield, net return, and benefit: cost ratio of urdbean crop.

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