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Research Paper

Influence of weed management practices on weed dynamics and yield of urdbean (*Vigna mungo*) under rainfed conditions of Jammu

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ABSTRACT

Experiments were conducted during *kharif* 2007 and 2009 in *Inceptisols*, to study the effect of different pre (PE) and post-emergence (POE) herbicides along with two hand weedings (HW) at 20 and 40 days after sowing (DAS) and weedy check on urdbean {*Vigna mungo* (L.) Hepper}. Highest seed yield was observed with two HWs at 20 and 40 DAS and the values were found statistically at par with POE application of imazethapyr 25 g/ha at 20 DAS. The highest weed control efficiency and lowest weed biomass was recorded with two HWs at 20 and 40 DAS followed by application of imazethapyr 25 g/ha (post-emergence) at 20 DAS. Application of Fenoxaprop-p-ethyl, quizalofop-p-ethyl, chlorimuron-p-ethyl as post-emergence and their combinations also reduced weed biomass and improved seed yield and yield attributing parameters as compared to weedy check. Treatment weedy check registered the highest values of weed count and weeds biomass and lowest seed yield and yield attributing characters in both the years of study. Rainfall was directly related to weed count and weed dry matter accumulation with the coefficient of 0.65 and 0.61, respectively. Weed dry matter accumulation was directly related with sunshine hours with an accuracy of 67%, whereas, weed count was lesser related with sunshine hours of the day with an accuracy of 34%. Grain and biological yield of urdbean crop decreased at the rate of 3.3 and 7.5 kg/ha under weedy check with an accuracy of 88 and 73%, respectively.

Key words: Post and pre-emergence herbicides, Urdbean, Weather parameters, Weed control

Urdbean is an important pulse crop of India cultivated on 2.73 million hectare area with total production of 1.18 million tonnes and average productivity of 432 kg/ha. (Anonymous, 2005). In Jammu and Kashmir State, urdbean is grown in about 16,000 hectares area mostly under rainfed conditions. Weeds are the salient competitors/removers of natural and man-made resources like nutrients, water and light, which could have been otherwise for boosting up crop productivity (Singh and Sheoran, 2008). The losses caused by weeds exceed the losses from any other category of agricultural pests. In *kandi* areas of Jammu region, farmers do not follow chemical weed control in pulses, except for 5–10% farmers who use pre-emergence herbicides followed by one or two hand-weedings. On small-scale farms, in developing countries more than 50% of labour time is devoted to weeding, manually (Ellis-Jones *et al*.1993, Akobundu, 1996). Therefore, control of the weeds by using herbicides is the only alternative to manage the weeds and thereby increasing the yield of urdbean. Since application of single herbicide may not be affective in providing broad spectrum weed control, hence, application of pre and post-emergence herbicides either in combination or sequence, or integration with manual weeding may be more beneficial. Keeping in view these facts, the present investigation was undertaken to test the performance of various post-emergence herbicides along with one pre-emergence and hand weeding for providing weed control during critical period of crop-weed interference in urdbean under dryland conditions.

MATERIALS AND METHODS

A field study was conducted during rainy (*kharif*) seasons of 2007 and 2009 at Pulses Research Sub-Station, Samba, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (32^0 34/ N, 70^0 83/ E, 330 m amsl). Nine weed control treatments comprising of *viz*., T_1: Weedy check (control); T_2: Hand-weeding (HW) at 20 and 40 days after sowing (DAS); T_3: Pendimethalin @ 1.0

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kg/ha (PE); T_4: Quizalofop-p-ethyl @ 37.5 g/ha at 20 DAS; T_5: Chlorimuron-p-ethyl @ 4 g/ha at 20 DAS; T_6: Fenoxaprop-p-ethyl @ 50 g/ha at 20 DAS; T_7: Quizalofop-p-ethyl @ 37.5 g/ha + Chlorimuron-p-ethyl @ 6 g/ha at 20 DAS; T_8: Fenoxaprop-p-ethyl @ 50 g/ha + Chlorimuron-p-ethyl @ 6 g/ha at 20 DAS and T_9: Imazethapyr @ 25 g/ha at 20 DAS were evaluated in randomized block design with three replications. The soil of the experimental site was sandy loam, having 0.32% organic carbon, 21.2 and 286 kg/ha available P and K, respectively. Urdbean '*Uttara*' was sown on 1 July, 2007 and 24 July, 2009 at 30 cm row-to-row spacing using 20 kg seed/ha and was harvested on 30 September, 2007 and 16 October, 2009. Recommended dose of fertilizers (20 kg N + 50 kg P/ha) was applied to urdbean crop at the time of sowing through diammonium phosphate (DAP). The different weather parameters were recorded during crop growing period in both the years. The mean maximum and minimum temperture recorded were in the range of 31.8 to 37.4^{0}C and 16.1 to 25.3^{0}C, respectively (mean of two years). The mean sunshine hours among differents weeks were 5.7 to 8.6 hrs in a day (Fig. 1). The total evaporation was observed 393.1 mm, while total rainfall recorded 789.1 mm during both years of study. The relative humidity in morning (RH1) and evening (RH2) were recorded in the range of 65 to 90 and 42 to 75%, respectively (Fig 2). Pre-emergence application of pendimethalin was done on next day of sowing and post-emergence application of other herbicides was done 20 DAS. Weed population was recorded by using 0.25 m^2 quadrate at 60 DAS in all the treatments and then converted into number of weeds/m^2. The weeds were dried in oven till a constant weight was observed and then transformed into g/m^2 by using the appropriate formula. Growth and yield parameters and yield of urdbean were recorded for both the years. The data on total weed count and weed dry matter were subjected to square root transformation ("x+0.5) to normalize their distribution (Gomez and Gomez, 1984). Weed control efficiency (Mani *et al*., 1973) and different indices (Devasenapathy *et al.* 2008) were worked out by the formula as below.

$$\text{WCE} = \frac{\text{WDC}-\text{WDT}}{\text{WDC}} \times 100$$

Where: WCE: Weed control efficiency; WDC: Weed dry matter in control; WDT: Weed dry matter in treatment

$$\text{Crop Resistance Index (CRI)} = \frac{\text{Dry matter production by the crop in the treatment plot}}{\text{Dry matter production in control}} \times \frac{\text{Dry matter production of weed in control plot}}{\text{Dry matter prod of weed in treatment plot}}$$

$$\text{Weed Management Index (WMI)} = \frac{\text{\% yield over control}}{\text{\% control of weed}}$$

RESULTS AND DISCUSSION

Effect on weeds

The experiment field was infested with *Cynadon dactylon*, *Commelina bengalensis*, *Cyperus rotundus*, *Ageratum coinzoides*, *Setaria gluaca*, *Euphorbia hirta*, *Echinochloa colonum*, *Echinochloa crusgalli*, *Tribulis terrestris*, *Trianthema monogyna*, *Ipomea pestigridis*, *Fimbristylis penera*, *etc*. species of weeds. The highest weed density (95/m^2) and total weed dry matter production (76.6 g/m^2) at 60 DAS were recorded in weedy check plots; whereas, the lowest total weed density (9/m^2) and total weed biomass (6.1 g/m^2) were recorded with application of imazethapyr @ 25 g/ha at 20 DAS, which was followed by two HWs at 20 and 40 DAS (Table 1). Higher weed control efficacy and long lasting effects of imazethapyr in reducing weed dry matter (upto 85%) might be primarily appeared due to broad-spectrum activity of herbicide particularly on established plants of both narrow and broad leaf weeds and its greater efficiency to retard cell division of meristems as a result of which weeds died rapidly. The results were confirmed by the findings of Kantar *et al*. (1999), where about 84.6% weed biomass was controlled with application of imazethapyr. Papierniks *et al*. (2003) also recommended use of imazethapyr in legumes, which inhibit acetohydroxy acid synthase and the synthesis of branched chain amino acids. Application of pendimethalin @ 1.0 kg/ha as PE also reduced the weed population and total weed dry matter to a notable level of 31/m^2 and 8 g/m^2, respectively. Data further revealed that among other herbicides, quizalofop-p-ethyl, chlorimuron-p-ethyl, fenoxaprop-p-ethyl either alone or in combination also reduced the density and dry matter of weeds in different proportions but were not statistically on par with hand weeding and imazethapyr treatment. The results are in conformity with the findings of Ceylan and Toker (2006), who reported a limited weed control by quizalofop-p-ethyl among various herbicides.

Weed control efficiency

The highest value of weed control efficiency (Table 1) was recorded under two HWs at 20 and 40 DAS (95%), followed by POE application of imazethapyr @ 25 g/ha at 20 DAS (92%) and PE application of pendimethalin @ 1.0 kg/ha (90%). Singh and Chandel (1995) also reported higher weed control efficiency with 2 hand weedings. The results were confirmed by the findings of Kantar *et al*. (1999), where 84.6% weed biomass was controlled with application of imazethapyr. However, the other herbicides quizalofop-p-ethyl, fenoxaprop-p-ethyl and chlorimuron-p-ethyl alone or in combination also registered notable values of weed control efficiency in the range of 78.8 to 89.3 per cent. Vyas and Jain (2003) also observed higher weed control efficiency, seed yield with application of imazethapyr over quizalofop-p-ethyl in soybean crop.

Yield components and yield

Different weed management practices had significant positive impacts on yield and yield components of urdbean crop (Table 1). Significant lowest values of plant height (59.6 cm), branches/plant (2.6), pods/plant (13.0), grains/pod (3.73), pod length (4.4 cm), seed and biological yield (411 and 1708 kg/ha) and harvest-index (24.3) were recorded under weedy check and the highest values for these parameters were recorded under two HWs at 20 and 40 DAS, which was found to be statistically at par with imazethapyr @ 25 g/ha and significantly superior to all other treatments. Higher level of these parameters could be attributed due to low crop-weed competition under treatments. Nelson and Renner (1999) also reported that imazethapyr gave seed yield statistically equal to the hand-weeded plots in soybean.

Seed and biological yield recorded with imazethapyr (75.2 and 45.7%) and pendimethalin (50.9 and 26.3%) higher over weedy check. However, seed and biological yield of urdbean with HWs at 20 and 40 DAS were 80.1 and 49.9% higher over weedy check (control). Whereas, Kantar *et al*. (1999) also observed 63.6% higher seed yield over unweeded check with application of imazethapyr @ 25 g/ha as POE.

Herbicides *viz.*, Fenoxaprop-p-ethyl @ 50 g/ha, quizalofop-p-ethyl @ 37.5 g/ha, quizalofop-p-ethyl @ 37.5 g/ha + chlorimuron-p-ethyl @ 6 g/ha, Fenoxaprop-p-ethyl @ 50 g/ha + chlorimuron-p-ethyl @ 6 g/ha and chlorimuron-p-ethyl @ 4 g/ha registered notable seed and biological yield values to the tune of 588 and 2271, 571 and 2253, 566 and 2228, 551 and 2183, 524 and 2030 kg/ha, respectively, which were 43.2 and 32.9, 39.0 and 31.9, 37.7 and 30.5, 34.0 and 27.8, 27.7 and 18.9% higher over weedy check (Table 1). Papiernik *et al*. (2003) and Kay and McMillan (1990) also recorded higher seed yield with imazethapyr application in chickpea as compared to the other herbicidal treatments. The highest value of B:C ratio to the tune of 1.08 was observed with application of imazethapyr @ 25 g/ha as POE, followed by the value 0.81 recorded in treatment Pendimethalin (PE) @ 1.0 kg/ha (Table 1). Highest value of crop resistance index (CRI) was obtained with two HWs at 20 and 40 DAS (6.2), which was followed by imazethapyr @ 25 g/ha with the values of 5.0, and pendimethalin 1.0 kg/ha with the values of 3.9 (Fig 3). Similar trend was also recorded in respect to weed management index (WMI).

Correlation matrix

Weeds/m^2 was positively correlated with weed biomass

Table 1. Effect of different weed management practices on weed dynamics (60 DAS), yield and yield parameters of urdbean crop (Pooled values)

Treatment	Weed density (no./m^2)	Weed dry matter (g/m^2)	Weed control efficiency (%)	Plant height (cm)	Branches/ plant	Pods/ plant	Grains/ pod	Pod length (cm)	Grain yield (kg/ha)	Biological yield (kg/ha)	Harvest index	Net returns (₹/ha)	B : C ratio
Weedy check	9.7(95)	8.8(76.6)	—	59.6	2.60	13.0	3.73	4.4	410	1707	24.3	3,142	0.28
Hand weeding at 20 & 40 DAS	4.3(18)	2.1(3.9)	95.0	72.2	5.90	26.3	5.83	5.3	740	2559	29.5	11,064	0.75
Pendimethalin @ 1.0 kg/ha (PE)	5.6(31)	2.9(8.0)	89.8	71.9	3.91	21.6	5.33	5.2	620	2156	29.9	9,724	0.81
Quizalofop-p-ethyl @ 37.5 g/ha (POE)	7.5(56)	3.0(8.7)	88.7	68.5	3.45	20.0	4.88	4.9	571	2253	25.5	7,841	0.65
Chlorimuron-p-ethyl @ 4 g/ha (POE)	8.3(70)	4.1(16.3)	78.8	63.2	2.83	14.7	3.98	5.1	524	2030	25.9	6,099	0.50
Fenoxaprop-p-ethyl @ 50 g/ha (POE)	6.0(36)	2.9(8.2)	89.3	68.3	3.70	20.9	5.13	5.0	588	2270	26.1	8,511	0.70
Quizalofop-p-ethyl @ 37.5 g/ha + Chlorimuron-p-ethyl @ 6 g/ha (POE)	8.5(73)	3.5(11.7)	84.7	67.5	3.36	18.5	4.53	4.9	566	2227	25.7	7,530	0.61
Fenoxaprop-p-ethyl @ 50 g/ha + Chlorimuron-p-ethyl @ 6 g/ha (POE)	7.9(63)	3.5(12.0)	84.3	63.8	3.30	16.0	4.18	4.9	550	2183	25.4	6,945	0.56
Imazethapyr @ 25 g/ha (POE)	2.9(09)	2.6(6.1)	92.1	76.2	5.40	23.2	5.68	5.3	719	2489	29.4	13,085	1.08
Mean	6.8(50.0)	3.7(16.8)	—	67.9	3.83	19.4	4.80	5.0	587	2208	26.8		
SEm±	0.20	0.14		1.0	0.6	2.5	0.3	0.1	16	56	0.2		
CD (P=0.05)	0.62	0.41		3.1	1.8	7.6	0.8	0.3	50	170	2.2		

*Data transformed using square root $\sqrt{x+0.5}$ and values in parenthesis are original accumulation. Weeds/m² and weed dry matter had highly negative correlation with seed, straw, biological yield and yield parameters of urdbean crop under rainfed conditions. Branches/plant, pods/plant, grains/pod and pod length were significantly highly correlated with plant height in urdbean crop (Table 2).

Weed count affected more yield and yield attributes of urdbean crop as compared to the weed dry matter accumulation in rainfed conditions. Seed and biological yields of urdbean crop decreased at the rate of 3.291 and 7.496 kg/ha due to weed infestation with an accuracy of 88 and 73%, respectively. Whereas, weed dry matter caused reduction at the rate of 5.83 and 9.17 kg/ha of grain and biological yield of mash crop with a coefficient of 0.71 and 0.70, respectively. Harvest index of urdbean crop related more accurately with the weed count as compared to weed dry matter accumulation among the pulse crop. The yield parameters like branches/plant, pods/plant, grains/pod and pod length decreased with an increase in weed count at the rate of 0.035, 0.136, 0.025 and 0.007 with an accuracy of 80, 83, 91and 54%, respectively (Table 3).

Weather parameters also affected growth and weed count in urdbean. Rainfall is directly related to weed count and weed dry biomass accumulation with the coefficient of 0.65 and 0.61, respectively (Fig. 4 A & B). Weed count and weed dry biomass increased with the increase in rainfall. Weed dry biomass accumulation was directly related with sunshine hours with an accurcy of 67%, whereas, weed count had been lesser related with sunshine hours of

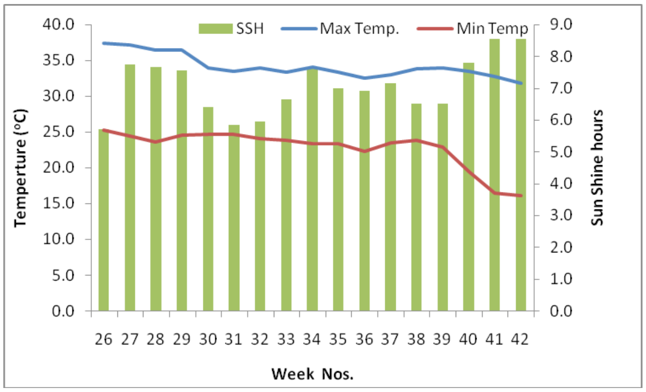

Fig. 1. Temperature and Sunshine hours (mean values) during crop growing period

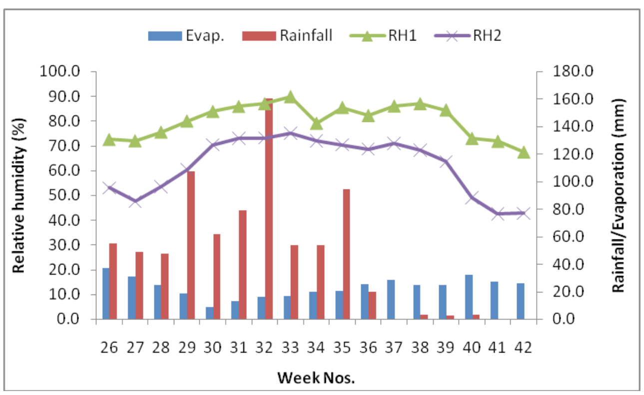

Fig. 2. Relative Humidity, rainfall and evaporation (mean values) during crop growing period

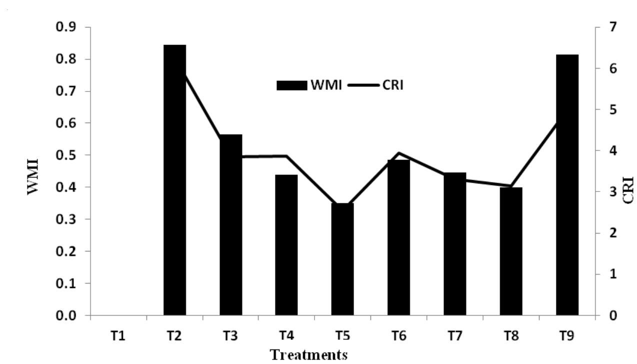

Fig. 3. Effect of different weed management treatments on Weed Management Index (WMI) and Crop Resistance Index (CRI) in urdbean crop (pooled values)

Table 2. Correlation matrix of weeds infestation and yield and yield parameters of urdbean crop

	Weed dry biomass	Seed yield	Straw yield	Biological yield	Harvest index	Plant height (cm)	Branches/ plant	Pods/ plant	Seeds/ pod	Pod length (cm)
Weed count	.698*	-.940**	- .763*	- .857**	- .880**	- .930**	- .888**	- .913**	- .957**	- .757*
Weed dry biomass		- .763*	- .844**	- .837**	- .545	- .706*	- .530	- .680*	- .673*	- .754*
Seed yield		1	.879**	.954**	.859**	.928**	.949**	.942**	.943**	.862**
Straw yield				.982**	.523	.772*	.783*	.828**	.795*	.686*
Biological yield				1	.673*	.858**	.873**	.899**	.878**	.777*
Harvest Index						.866**	.830**	.823**	.859**	.827**
Plant height (cm)						1	.854**	.916**	.957**	.772*
Branches/plant								.916**	.908**	.751*
Pods/plant								1	.985**	.728*
Seeds/pod										.729*
Pod length (cm)										1

*Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed)

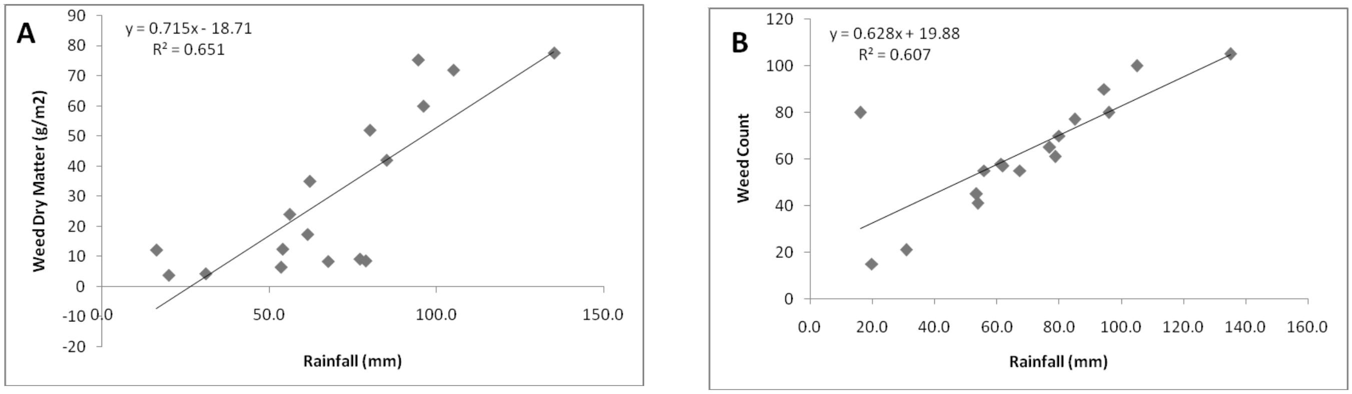

Fig. 4. Effect of rainfall (mm) on (A) weed dry biomass (g/m^2) and (B) weed count (pooled values)

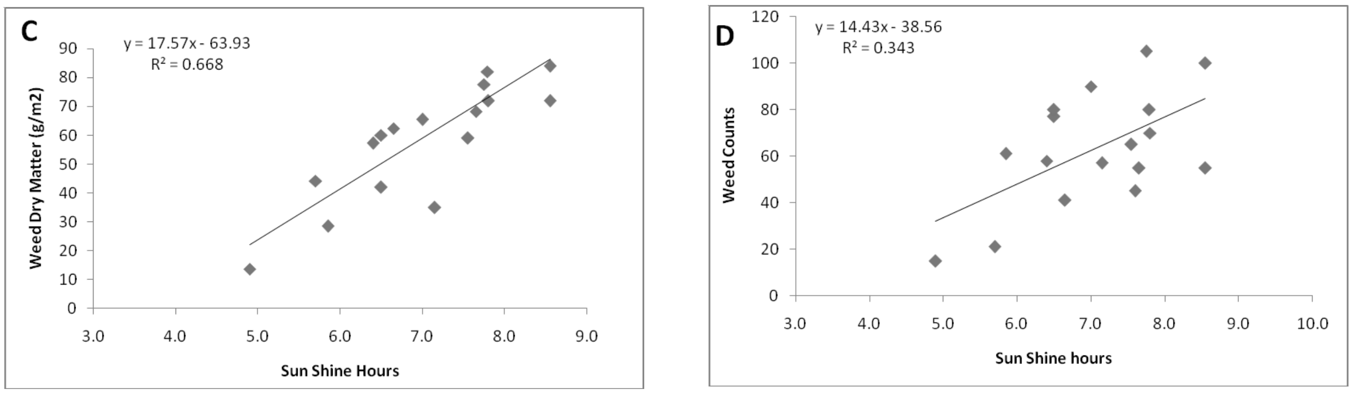

Fig. 5. Effect of sunshine hours on weed dry biomass (g/m^2) (C) and weed count (D) (pooled values)

Table 3. Relationship of weed count and weed dry biomass with yield and yield parameters of urdbean crop

S. No.	Parameters	Weed count			Weed dry matter (g/m^2)		
		Constant (a)	Slope	R^2	Constant (a)	Slope	R^2
1	Seed yield (Kg/ha)	752.30	- 3.291	0.88	1718.0	-5.83	0.71
2	Biological yield (Kg/ha)	2583.00	- 7.496	0.73	2362.0	-9.17	0.70
3	Harvest index	30.11	- 0.065	0.78	27.69	-0.050	0.30
4	Branches/plant	5.57	- 0.035	0.80	4.27	-0.026	0.28
5	Pods/plant	26.18	- 0.136	0.83	21.50	-0.131	0.46
6	Seeds/pod	6.06	- 0.025	0.91	5.170	-0.021	0.44
7	Pod length (cm)	5.34	0.007	0.54	5.11	0.009	0.52
8	Plant height (cm)	76.28	- 0.168	0.86	70.57	-0.161	0.50

the day with an accuracy of 34% (Fig 5 C & D).

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