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Studies on efficacy of pre-mix penoxsulam + pendimethalin on weed growth of direct seeded rice

Manisha Uraon

Abstract
The present investigation entitled “Sudies on efficacy of pre- mix penoxsulam + pendimethalin on weed growth, yield and economics of direct seeded rice” was carried out at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur during kharif season of 2015. The soil of experimental field was sandy loam in texture (Inceptisols), neutral in pH and has 0.44 % organic carban, low nitrogen, medium phosphorus and high potassium content. Experiment was laid out in Randomized Block Design (RBD) with three replications. The result of experiments indicated that the treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) registered maximum growth characters of rice like plant height, dry matter, number of tillers, leaf area, leaf area index, CGR.

Keywords: Penoxsulam and pendimethalin

Introduction

Rice (*Oryza sativa* L.) is the most consumed cereal grain in the world, constituting the dietary staple food for more than half of the planet’s human population. In world, rice is the second most widely consumed cereal next to wheat and it has occupied an area of 156.7 m ha, with a total production of 650.2 m t in 2014-15. According to the Food and Agriculture Organization (FAO) of the U.N. (2015), 80% of the world rice production mainly comes from Asian countries and Brazil. Among these countries, China is the largest producer of rice with a production of 197.26 m t and occupying an area of 30.30 m ha and with a productivity of 6.59 t ha^{-1}. In Asian countries, rice is major staple crop covering about ninety per cent of rice grown in the world. Hence, there is a need to increase the productivity of rice.

Chhattisgarh state is popularly known as “rice bowl of India” because maximum area is covered under rice during *kharif* and contribute major share in national rice production. The state is completely dependent on monsoon with an annual rainfall 1200-1600 m m. It has geographical area of 13.51 m ha of which 5.9 m ha area is under cultivation. Rice occupies an area of 3.68 mha with productivity of 20.20 q ha^{-1}. In Chhattisgarh, rice is mainly grown under rainfed ecosystem, which covers about 74, 97 and 95 per cent cropped area of Chhattisgarh plain, Bastar plateau and Northern hill zones, respectively. Chhattisgarh state contributes 5.26 per cent of the total rice production of the country. However, the production and productivity of rice per unit area is very low (Anonymous, 2015b) [2].

Hand weeding is the most common and effective method of weed control in rice but it is being difficult and uneconomical day-by-day due to high wages and non-availability of labours at peak period of farm operation (Singh *et al*., 1999) [12]. Herbicide is the most effective and economic means of weed control, but inappropriate or wrong application may not only increase production cost and yield penalty but also may cause development of herbicide resistant weeds and environmental hazard (Karim *et al.*, 2004) [6]. In some instances, weed competition is so intense that failure to control weeds in direct seeded rice may result yield loss from 65 to 92 per cent (Naresh *et al*., 2011). Therefore, timely weed control is imperative for realizing desired level of productivity. Accordingly, an efficient and economic weed management programme is necessary to control different types of weeds throughout the cropping period. In rice, the conventional method of weed control i.e hand weeding is very laborious, expensive and inefficient. Herbicidal weed control methods offer an advantage to save labor and money, as a result, regarded as cost effective method of weed control (Ahmad *et al*., 2000) [3].

Material and Method

1. Plant population (m^{-1} row length)

Plant population was counted m^{-1} row length randomly at three places in each plot at 15 DAS and at harvest. The average value was worked out by dividing the summation with three.

2. Plant heights (cm)

The plant height of five randomly selected plants from each plot was measured at an interval of 15 days starting from 15, 30, 45, 60 DAS and finally at harvest. The height was measured in cm from ground level to tip from the longest leaf until the panicles emerged. Afterward the average height was worked out by taking mean.

3. Dry matter accumulations (g $plant^{-1}$)

To obtain dry matter, five plant from each plot were taken at 15, 30, 45, 60 DAS and at harvest. The plants were kept in oven at 60°C for 48 hours to obtain the constant dry weight. After drying, the samples were weighted and average reading was noted in g $plant^{-1}$.

4. Number of tillers m^{-1} row length

Number of tillers m^{-1} row length were counted at 30, 45, 60 DAS at five places already demarked with bamboo pegs in each plot and then mean was calculated.

5. Leaf areas (cm^2)

Leaf area per plant was worked out as per procedure given by Gomez (1972). Five plants from each plot were collected. The length and width of respective leaf was measured with the help of scale. The leaf area was worked out at 15, 30, 45, and 60 DAS and at harvest by the following formula:

Leaf area = Length x Width x Correction factor (K)

Correction factor 0.75 was used as suggested by IRRI.

6. Leaf area index (LAI)

Leaf area index was calculated at 15, 30, 45, 60 DAS and at harvest by following formula:

$$\text{Leaf area index} = \frac{\text{Total leaf area of plant}}{\text{Total ground area of plant}}$$

7. Crop growth rate (g day^{-1} $plant^{-1}$)

CGR do notes overall growth rate of the crop plants and measured after the fixed period of time, irrespective of the previous growth rate. The values were calculated by using the following formula as suggested by Leopold and Kridemann (1975). The unit of CGR is g day^{-1} $plant^{-1}$. Crop growth rate was calculated between 15-30, 30-45, 45-60, 60 DAS- at harvest.

$$\text{Crop growth rate (g day}^{-1}\text{ plant}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1}$$

Where,

$W_1 - W_2$ = Difference in oven dry biomass at the time interval t_1-t_2

$t_1 - t_2$ = Time interval in days

8. Relative growth rates (g g^{-1} day^{-1} $plant^{-1}$)

RGR is a measure used to quantify the speed of plant growth. It is measured as the mass increase per aboveground biomass per day. The RGR was worked out with the help of following formula:

$$\text{Relative growth rate (g g}^{-1}\text{ day}^{-1}\text{ plant}^{-1}) = \frac{LnW_2 - LnW_1}{t_2 - t_1}$$

Where,

LnW_1 and LnW_2 are the natural logarithum of total dry weight of plant at time interval t_2 and t_1 respectively.

1. Plant population (m^{-1} row length)

The data on plant population at 15 DAS is represented in Table 1.1 It indicates that there was no significant variation in the number of plants m^{-1} row length at 15 DAS.

2. Plant heights (cm)

Plant height is one of the important growth parameters of any crop plants as it determines or modifies the yield contributing characters and finally shapes the grain yield. For the ideal rice variety, the height of the plant should be medium type. The data presented in Table 1 reveal that different combination of herbicides significantly affected the plant height at different time interval of observations except at 15 DAS. In general, plant height increased with the advancement in age of the crop but maximum increase was recorded from 15 to 45 DAS in all the treatments and afterwards, it increased with slow pace.

At 30, 45, 60 DAS and at harvest, significantly tallest plant height was registered under treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) which was significantly superior over others. However, it was at par to treatments Penoxsulam + Pendimethalin (10+240 g/l) SE @ 22.5 + 540 g a.i. ha^{-1} (T_2), Penoxsulam + Pendimethalin (10+240 g/l) SE @ 25 + 600 g a.i. ha^{-1} (T_3), Penoxsulam + Pendimethalin (10+240 g/l) SE @ 50 + 1200 g a.i. ha^{-1} (T_4), Penoxsulam 24% SC @ 22.5 g a.i. ha^{-1} (T_7), Penoxsulam 24% SC @ 25 g a.i. ha^{-1}(T_8) and hand weeding at 20 and 35 DAS (T_{13}). The dwarfest plants at these stages were registered under weedy check (T_{14}).

The reason for variation in plant height in different treatments may be due to the lower competition of weeds with crop for light, nutrients and space along with availability of water which allow the crop to grow to their potential. These results are also in accordance with the findings of Nerwal *et al*. (2002), Pal *et al*. (2002) [8], Hasanuzzaman and Karim (2007) [6], Sori (2008) [13], Yadav *et al*. (2009) [14] and Saha and Rao (2010) [10].

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

Data with respect to dry matter of plants are presented in Table 2 and it was observed that dry matter of rice crop was increased with the advancement of crop age under all the treatment and it was maximum at harvest. Dry matter of rice was significantly influenced by the different combination of herbicides throughout the crop growth period, except at 15 DAS.

In general, all the plots where herbicides applied to control weeds were accumulated more dry matter of rice over weedy check. At 30, 45, 60 DAS and at harvest, significantly highest dry matter was registered under treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) which was significantly superior over others, but it was at par with treatments, Penoxsulam + Pendimethalin (10+240 g/l) SE @ 22.5 + 540 g a.i. ha^{-1} (T_2), Penoxsulam +

Pendimethalin (10+240 g/l) SE @ 25 + 600 g a.i. ha^{-1} (T_3), Penoxsulam + Pendimethalin (10+240 g/l) SE @ 50 + 1200 g a.i. ha^{-1} (T_4), Penoxsulam 24% SC @ 22.5 g a.i. ha^{-1} (T_7), Penoxsulam 24% SC @ 25 g a.i. ha^{-1}(T_8) and hand weeding at 20 and 35 DAS (T_{13}). The lowest dry matter of plants at all the stages of growth was noted under untreated check (T_{14}). The higher dry matter of plants in above treatments might be due to the reduction in crowding effect or weed population among the crop plants, which facilitate more space, nutrients, light and moisture for their proper growth and development leads to maximum accumulation of dry matter per unit area of rice plant. The lowest dry matter of rice was recorded under weedy check (T_{14}) at all time intervals of observations. It might be due to adverse effect of excessive crop- weed competition as evident from maximum dry matter production of weeds which resulted in reduction of nutrient uptake and dry matter accumulation by crop. Similar results have been reported by Singh *et al*. (1995) [12] and Singh and Bhan (1998) [12].

4. Number of tillers (m^{-1} row length)

Number of tillers m^{-1} row length of rice was noted at 30, 45, 60 DAS and data are presented in Table 3 At 30, 45, 60 DAS, the number of tillers m^{-1} row length was significantly highest under treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) though it was at par with application of Penoxsulam + Pendimethalin (10+240 g/l) SE @ 50 + 1200 g a.i. ha^{-1} (T_4), Penoxsulam 24% SC @ 22.5 g a.i. ha^{-1} (T_7), Penoxsulam 24% SC @ 25 g a.i. ha^{-1}(T_8) and hand weeding at 20 and 35 DAS (T_{13}). The minimum number of tillers was observed under weedy check (T_{14}).

Highest number of tillers under these treatments were due to the fact that there was congenial environment for proper growth and development of rice plant and there was more space to the crop to show their potential due to lower weed competition in terms of dry matter of weeds, which allowed crop to absorb required amount of nutrient, water and sunlight for its growth and tillering behavior. Similar results have been reported by Nerwal *et al.* (2002), Sandeep *et al*. (2002) [11] EI-Desoki (2003) [4] and Ashraf *et al*. (2006) [12].

5. Leaf area (cm^2)

The data on leaf area as affected by various treatments are presented in Table 4 Leaf area of rice was significantly influenced by the different combination of herbicides throughout the crop growth period, except at 15 DAS. At 30, 45, 60 DAS and at harvest, maximum leaf area was observed under the treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) which was significantly superior over others, however, treatments Penoxsulam + Pendimethalin (10+240 g/l) SE @ 22.5 + 540 g a.i. ha^{-1} (T_2), Penoxsulam + Pendimethalin (10+240 g/l) SE @ 25 + 600 g a.i. ha^{-1} (T_3), Penoxsulam + Pendimethalin (10+240 g/l) SE @ 50 + 1200 g a.i. ha^{-1} (T_4), Penoxsulam 24% SC 22.5 g a.i. ha^{-1} (T_7), Penoxsulam 24% SC 25 g a.i. ha^{-1}(T_8) and hand weeding at 20 and 35 DAS (T_{13}) also registered at par leaf area to treatment Penoxsulam + Pendimethalin @ 100 + 2400 g a.i. ha^{-1} (T_5).

6. Leaf area index (LAI)

The data on leaf area index as affected by various treatments are presented in Table 5a. Leaf area index of rice was significantly influenced by the different combination of herbicides throughout the crop growth period, except at 15 DAS. At 30, 45, 60 DAS and at harvest, maximum leaf area index was observed under the treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) which was significantly superior over others, however, treatments Penoxsulam + Pendimethalin (10+240 g/l) SE @ 22.5 + 540 g a.i. ha^{-1} (T_2), Penoxsulam + Pendimethalin (10+240 g/l) SE @ 25 + 600 g a.i. ha^{-1} (T_3), Penoxsulam + Pendimethalin (10+240 g/l) SE @ 50 + 1200 g a.i. ha^{-1} (T_4), Penoxsulam 24% SC 22.5 g a.i. ha^{-1} (T_7), Penoxsulam 24% SC 25 g a.i. ha^{-1}(T_8) and hand weeding at 20 and 35 DAS (T_{13}), also registered at par leaf area index to treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5).

The increase in LAI under above mentioned treatments might be due to production of higher number of leaves, which increased total photosynthetic surfaces with increase in leaf area and secondly due to increased availability of nitrogen, which resulted in large leaves. In addition water availability enhances cell development and cell growth and this probably resulted in higher leaf area index and higher plant height. Also increasing water availability might be contributed to high yield. These results are in accordance with the findings of Yadav *et al*. (2009) [12] and Halder and Patra (2010) [12].

7. Crop growth rate (g day^{-1} $plant^{-1}$)

Crop growth rate of rice was computed at 15-30 DAS, 30-45 DAS, 45-60 DAS, and 60 DAS- at harvest stage and data are presented in Fig. The trend showed that the crop growth rate increased upto 60DAS-At harvest due to panicle initiation and grain filling. Different combination of herbicides significantly affected the crop growth rate during 15-30 DAS, 30-45 DAS, 45-60 DAS and 60 DAS-At harvest. The maximum crop growth rate was observed under treatment Penoxsulam + Pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) and minimum crop growth rate was observed under treatment weedy check (T_{14}).

Increase in CGR at early stages may be due to active participation of leaves in photosynthesis and less density of weeds. Decline crop growth rate was caused by senescence of leaves probably owing to competition from weeds for solar radiation and also due to density of weeds higher in these periods (Rao and Singh, 1997 and Singh and Bhan, 1998) [12].

8. Relative growth rate (g g^{-1} day^{-1} $plant^{-1}$)

The relative growth rate pattern is presented in Fig. 4.2. The data reveal that the, highest relative growth rate was observed under treatment Penoxsulam + pendimethalin (10+240 g/l) SE @ 100 + 2400 g a.i. ha^{-1} (T_5) which was followed by treatments Penoxsulam + Pendimethalin (10+240 g/l) SE @ 50 + 1200 g a.i. ha^{-1} (T_4). The minimum relative growth rate value was noticed in weedy check treatment (T_{14}).

Table 1: Plant height at different stages as influenced by combination of herbicides

Treatment		Dosage		Time of application DAS	Plant height (cm)				
		g a.i. ha⁻¹	Formulation ml ha⁻¹		15 DAS	30 DAS	45 DAS	60 DAS	At harvest
T_1	Penoxsulam + Pendimethalin (10+240 g/l) SE	20+480	2000	7	28.90	51.27	63.43	64.53	80.53
T_2	Penoxsulam + Pendimethalin (10+240 g/l) SE	22.5+540	2250	7	29.57	53.27	67.47	68.77	85.70
T_3	Penoxsulam + Pendimethalin (10+240 g/l) SE	25+600	2500	7	29.60	54.53	68.53	68.78	86.37
T_4	Penoxsulam + Pendimethalin (10+240 g/l) SE	50+1200	5000	7	28.60	56.63	70.20	75.33	91.20
T_5	Penoxsulam + Pendimethalin (10+240 g/l) SE	100+2400	10000	7	28.69	57.83	72.70	78.53	92.37
T_6	Penoxsulam 24% SC	20	83.33	7	28.13	51.07	62.37	61.80	79.77
T_7	Penoxsulam 24% SC	22.5	93.75	7	29.70	54.87	68.60	72.53	88.07
T_8	Penoxsulam 24% SC	25	104.17	7	29.90	55.63	69.97	73.17	89.20
T_9	Pendimethalin 30%EC	540	1800	7	27.23	46.47	58.93	61.00	78.23
T_{10}	Pendimethalin 30%EC	600	2000	7	27.87	47.50	61.43	61.63	78.93
T_{11}	Pendimethalin 30%EC	1000	3333.33	7	27.90	51.56	65.03	66.20	81.01
T_{12}	Pendimethalin 30%EC	1500	5000	7	28.17	51.53	64.70	65.00	80.37
T_{13}	Hand weeding	NA	NA	20 & 35	30.23	56.07	70.17	74.00	91.10
T_{14}	Untreated check	-	-	-	30.33	43.57	50.57	59.53	74.70
SEm±					2.12	2.10	2.27	3.37	3.77
CD (P=0.05)					NS	6.12	6.61	9.82	10.98

Table 2: Dry matter accumulation at different stages as influenced by combination of herbicide

Treatment		Dosage		Time of application DAS	Dry matter accumulation (g plant⁻¹)				
		g a.i. ha⁻¹	Formulation ml ha⁻¹		15 DAS	30 DAS	45 DAS	60 DAS	At harvest
T_1	Penoxsulam + Pendimethalin (10+240 g/l) SE	20+480	2000	7	0.26	0.45	0.99	1.51	5.45
T_2	Penoxsulam + Pendimethalin (10+240 g/l) SE	22.5+540	2250	7	0.26	0.58	1.14	1.63	6.68
T_3	Penoxsulam + Pendimethalin (10+240 g/l) SE	25+600	2500	7	0.27	0.59	1.16	1.70	6.69
T_4	Penoxsulam + Pendimethalin (10+240 g/l) SE	50+1200	5000	7	0.26	0.64	1.23	2.06	7.10
T_5	Penoxsulam + Pendimethalin (10+240 g/l) SE	100+2400	10000	7	0.26	0.66	1.29	2.11	7.16
T_6	Penoxsulam 24% SC	20	83.33	7	0.30	0.43	0.96	1.49	4.98
T_7	Penoxsulam 24% SC	22.5	93.75	7	0.30	0.60	1.18	1.97	6.70
T_8	Penoxsulam 24% SC	25	104.17	7	0.26	0.62	1.19	1.98	6.76
T_9	Pendimethalin 30%EC	540	1800	7	0.30	0.38	0.76	1.22	4.24
T_{10}	Pendimethalin 30%EC	600	2000	7	0.26	0.40	0.83	1.37	4.62
T_{11}	Pendimethalin 30%EC	1000	3333.33	7	0.25	0.48	1.03	1.56	5.77
T_{12}	Pendimethalin 30%EC	1500	5000	7	0.27	0.46	0.99	1.54	5.75
T_{13}	Hand weeding	NA	NA	20 & 35	0.32	0.63	1.20	2.04	6.98
T_{14}	Untreated check	-	-	-	0.31	0.34	0.67	1.08	4.08
SEm±					0.02	0.03	0.05	0.17	0.26
CD (P=0.05)					NS	0.10	0.16	0.49	0.76

Table 3: Plant population and number of tillers at different stages as influenced by combination of herbicides

Treatment		Dosage		Time of application DAS	Plant population at 15 DAS (m⁻¹ row length)	No. of tillers (m⁻¹ row length)		
		g a.i. ha⁻¹	Formulation ml ha⁻¹			30 DAS	45 DAS	60 DAS
T_1	Penoxsulam + Pendimethalin (10+240 g/l) SE	20+480	2000	7	49.11	50.22	62.89	65.78
T_2	Penoxsulam + Pendimethalin (10+240 g/l) SE	22.5+540	2250	7	49.04	59.31	67.41	73.64
T_3	Penoxsulam + Pendimethalin (10+240 g/l) SE	25+600	2500	7	49.00	62.70	70.48	76.03
T_4	Penoxsulam + Pendimethalin (10+240 g/l) SE	50+1200	5000	7	47.77	72.32	78.45	85.63
T_5	Penoxsulam + Pendimethalin (10+240 g/l) SE	100+2400	10000	7	47.67	74.28	80.26	88.25
T_6	Penoxsulam 24% SC	20	83.33	7	49.12	47.04	60.34	62.36
T_7	Penoxsulam 24% SC	22.5	93.75	7	49.10	66.86	73.60	78.86
T_8	Penoxsulam 24% SC	25	104.17	7	48.79	68.57	74.41	80.24
T_9	Pendimethalin 30%EC	540	1800	7	49.13	42.51	54.86	56.39
T_{10}	Pendimethalin 30%EC	600	2000	7	49.19	45.42	56.84	58.84
T_{11}	Pendimethalin 30%EC	1000	3333.33	7	49.23	56.21	65.37	70.96
T_{12}	Pendimethalin 30%EC	1500	5000	7	48.79	53.07	64.02	67.40
T_{13}	Hand weeding	NA	NA	20 & 35	49.29	69.85	76.65	83.52
T_{14}	Untreated check	-	-	-	50.00	36.29	53.39	54.29
SEm±					0.59	2.80	3.25	3.58
CD (P=0.05)					NS	8.15	9.47	10.41

Table 4: Leaf area at different stages as influenced by combination of herbicides

Treatment		Dosage		Time of	Leaf area (cm²)				
		g a.i. ha⁻¹	Formulation ml ha⁻¹	application DAS	15 DAS	30 DAS	45 DAS	60 DAS	At harvest
T_1	Penoxsulam + Pendimethalin (10+240 g/l) SE	20+480	2000	7	62.77	131.73	324.22	538.03	730.00
T_2	Penoxsulam + Pendimethalin (10+240 g/l) SE	22.5+540	2250	7	62.85	147.11	342.51	586.59	786.70
T_3	Penoxsulam + Pendimethalin (10+240 g/l) SE	25+600	2500	7	62.79	149.58	345.39	590.47	790.07
T_4	Penoxsulam + Pendimethalin (10+240 g/l) SE	50+1200	5000	7	62.65	158.70	356.31	606.84	806.11
T_5	Penoxsulam + Pendimethalin (10+240 g/l) SE	100+2400	10000	7	61.99	160.74	360.65	608.57	810.14
T_6	Penoxsulam 24% SC	20	83.33	7	63.02	128.38	319.33	530.64	725.40
T_7	Penoxsulam 24% SC	22.5	93.75	7	62.93	151.76	347.38	594.60	794.00
T_8	Penoxsulam 24% SC	25	104.17	7	63.11	153.85	350.43	598.59	796.11
T_9	Pendimethalin 30%EC	540	1800	7	62.74	116.61	288.67	518.53	702.18
T_{10}	Pendimethalin 30%EC	600	2000	7	62.77	120.00	309.33	522.80	718.17
T_{11}	Pendimethalin 30%EC	1000	3333.33	7	62.78	136.07	328.02	548.64	746.42
T_{12}	Pendimethalin 30%EC	1500	5000	7	62.81	134.07	327.21	540.23	742.33
T_{13}	Hand weeding	NA	NA	20 & 35	63.32	156.70	353.58	602.73	802.33
T_{14}	Untreated check	-	-	-	63.01	102.73	226.38	496.24	600.67
SEm±					0.33	5.22	10.82	16.29	19.71
CD (P=0.05)					NS	15.20	31.47	47.37	57.31

Table 5: Leaf area index at different stages as influenced by combination of herbicides

Treatment		Dosage		Time of	Leaf area index				
		g a.i. ha⁻¹	Formulation ml ha⁻¹	application DAS	15 DAS	30 DAS	45 DAS	60 DAS	At harvest
T_1	Penoxsulam + Pendimethalin (10+240 g/l) SE	20+480	2000	7	0.31	0.66	1.62	2.69	3.65
T_2	Penoxsulam + Pendimethalin (10+240 g/l) SE	22.5+540	2250	7	0.31	0.74	1.71	2.93	3.93
T_3	Penoxsulam + Pendimethalin (10+240 g/l) SE	25+600	2500	7	0.31	0.75	1.73	2.95	3.95
T_4	Penoxsulam + Pendimethalin (10+240 g/l) SE	50+1200	5000	7	0.31	0.79	1.78	3.03	4.03
T_5	Penoxsulam + Pendimethalin (10+240 g/l) SE	100+2400	10000	7	0.31	0.80	1.80	3.04	4.05
T_6	Penoxsulam 24% SC	20	83.33	7	0.32	0.64	1.60	2.65	3.63
T_7	Penoxsulam 24% SC	22.5	93.75	7	0.31	0.76	1.74	2.97	3.97
T_8	Penoxsulam 24% SC	25	104.17	7	0.32	0.77	1.75	2.99	3.98
T_9	Pendimethalin 30%EC	540	1800	7	0.31	0.58	1.44	2.59	3.51
T_{10}	Pendimethalin 30%EC	600	2000	7	0.31	0.60	1.55	2.61	3.59
T_{11}	Pendimethalin 30%EC	1000	3333.33	7	0.31	0.68	1.65	2.74	3.73
T_{12}	Pendimethalin 30%EC	1500	5000	7	0.21	0.67	1.64	2.70	3.71
T_{13}	Hand weeding at 20 & 35 DAS	NA	NA	20 & 35	0.32	0.78	1.77	3.01	4.01
T_{14}	Untreated check	-	-	-	0.32	0.51	1.13	2.48	3.00
SEm±					0.02	0.02	0.05	0.08	0.09
CD (P=0.05)					NS	0.07	0.15	0.23	0.28

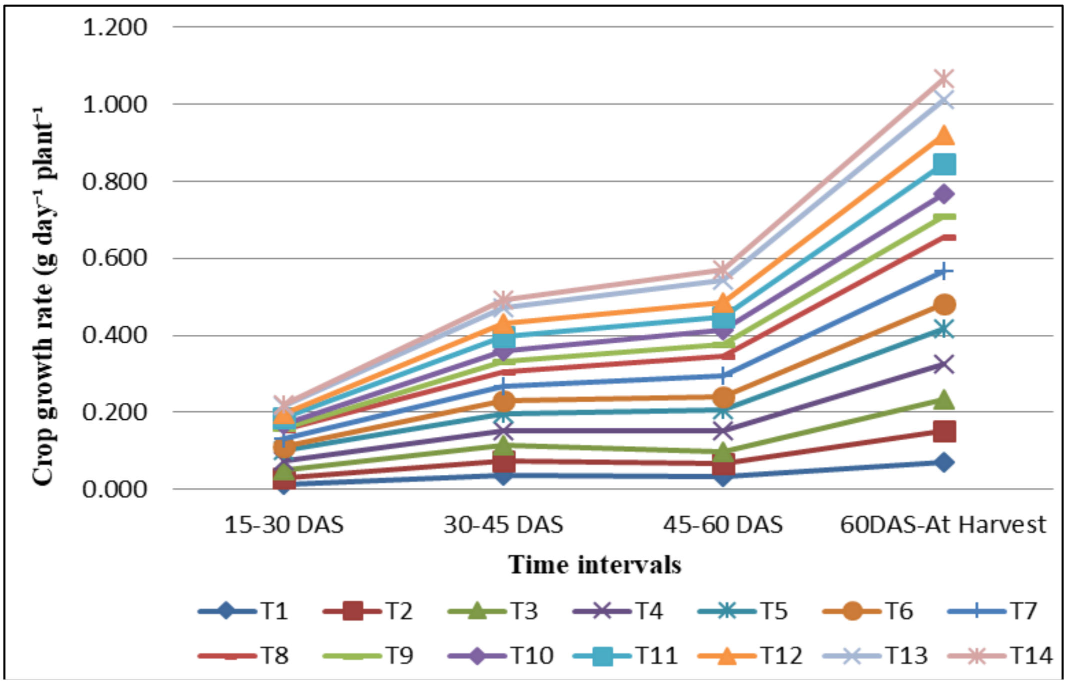

Fig 1: Crop growth rate at different stages as influenced by combination of herbicides

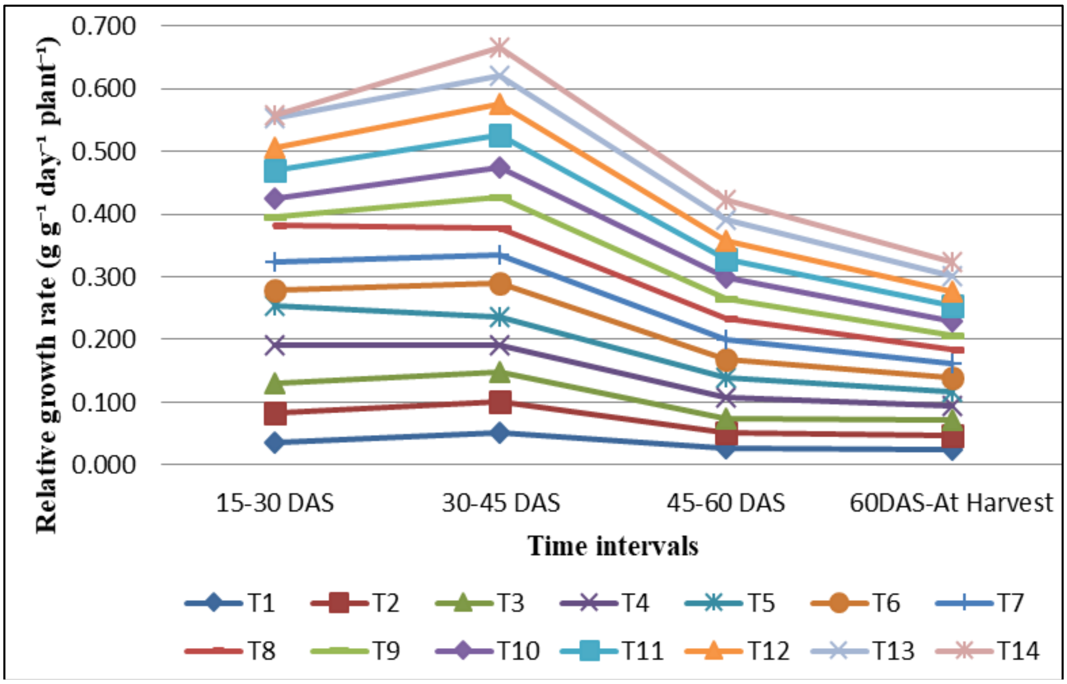

Fig 2: Relative growth rate at different stages as influenced by combination of herbicides

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