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Original Research Article

Economic Management for Higher Grain Yield under Integrated Crop Management in Lentil

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Keywords

Lentil, Nutrient management, RDF, Pest management, Weed management

A B S T R A C T

Experiments were conducted during *Rabi* 2014-15 at GPB, Farm Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya to "find out economic management for higher grain yield under integrated crop management in lentil". The experiment consisted of eight treatments *viz*. T_1- Control, T_2- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha), T_3- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS, T_4- Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, T_5- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS, T_6- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, T_7-Weed management (WM)-Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water and T_8- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, were applied.The results revealed that integrated crop management practices reduced the disease and pest incidence in lentil. Analysis of the data showed that among the treatment with Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, achieved highest grain yield of lentil 1433 kg/ha, yield increase 161.02%, followed by treatment of nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS grain yield of 1305 kg/ha and percentage increase of yield 137.70, compare to control plot grain yield 549 kg/ha. Treatment with nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water highest gross return of Rs. 23645/ha and additional net return of Rs.14586/ha as compared to control followed by treatment of nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS gross return of Rs. 21533/ha and additional net return over control of Rs.12474/ha.

Introduction

Lentil (*Lens esculenta* Moench.) is one of the important *Rabi* pulse crops of India next to gram. India is the largest producer contributing about 32% of world lentil production. It is cultivated in an area of 1.42 million hectare with a production of 1.13 million tonnes and productivity of 797 kg/ha during 2012-13 (Reddy and Reddy, 2010, Anonymous, 2014). Its seed is a rich source of protein, minerals, and vitamins for human nutrition, and the straw is a valued animal feed. Its ability in nitrogen and carbon sequestration adds to soil fertility (Sarker and Erskine, 2006). The nutrient value of lentil composed of 60 % of Carbohydrates26 % of protein, 7.5 % of iron, 2 % of sugars and 0.87 of thiamine vitamin B1 (Sharara *et al.*, 2011). During twelfth plan (2012-15) the country's area under Lentil was 14.79 lakh hectares with a production of 10.38 lakh tonnes. Madhya Pradesh ranks first in average i.e., 39.56% (5.85 lakh ha) followed by UP 34.36 % and Bihar 12.40%. While in terms of production UP ranks first at 36.65% (3.80 lakh tonnes) followed by Madhya Pradesh (28.82%) and Bihar (18.49%).The highest yield was recorded by the state of Bihar (1124 kg/ha) followed by W.B. (961 kg/ha) and Jharkhand (956 kg/ha). The National yield average was (753 kg/ha). The lowest yield was observed in the state of Maharashtra (379 kg/ha), followed by and M.P. (634 kg/ha) (DES, 2015-16). The lower production and productivity are mostly due to several problems with the lentil growing farmer's particularly improper knowledge on package of practices. Pulses play an important role in rainfed as well as partially irrigated agriculture by improving physical, chemical, and biological properties of soil and are considered excellent crops for natural resource management, environmental security, crop diversification and consequently for viable agriculture (Kannaiyan, 1999; Ali and Kumar, 2006). The energy content of most pulses has been found to be between 315 and 432 Kcal/100g with high protein content which is about twice as compared to cereal and several times than root tuber (FAO, 1986, Kushwah *et al.*, 2002).

Among the different crop management practices, weed management is of key importance as 20 to30 % losses in grain yield are quite usual and may increase even 50%, if the weed management practices are not properly followed (Tanveer and Ali, 2003).Inadequate weed control was found to reduce the yield 40-66 % in lentil (Singh & Singh, 1983). Weeds exhaust soil depriving the crop of nutrients causing a considerable reduction in yield. Herbicides have come as a big boon to farmers in areas where the labour supply is limited and wages are high. Application of herbicide can minimize weed infestation if the field can be kept weed free during the critical growth period. Ahlawat *et al.,* 1981, reported that the most critical period of weed competition in lentil is first 4-8weeks.The practical utility of any weed control measure can be best judged based on its economic feasibility besides its efficient weed control. According to (Barros *et al.*, 2008) the aim of weed management is to keep the weed community at an acceptable level rather than to keep the crop totally free of weeds. Hence, proper choice of the weed management system would be viable, effective and economical with the varying intensity of weed species, population and their dominant effect on the short stature crops like lentil. IPM is an ecological approach aimed at significantly reducing use of pesticides while managing pest populations at an acceptable level. IPM uses an array of complementary methods including mechanical and physical devices, as well as genetic, biological, cultural management, and chemical management. It

uses strategies of prevention, observation, and intervention with a main goal of significantly reducing the use of pesticide. Benefits include the reduction in cost, contamination, residues and resistance to the pesticide. Regular monitoring, with accurate pest identification, is the key to IPM. For insects, monitoring for beneficial organisms and predators is important too. Record-keeping is essential, as is knowledge of the behavior and reproductive cycles of target pests.

Materials and Methods

The field experiment was conducted during *Rabi* season of 2014-15 in Genetics and Plant Breeding farm, Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya of latitude 26.47^0N, longitude 82.12^0 E and 113 meter of see level in Randomized Block Design (RBD) with eight treatment *i.e.;* T_1- Control, T_2- Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha), T_3- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS, T_4- Pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, T_5- Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS, T_6- Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, T_7-Weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water and T_8- Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, were applied. The soils of experimental field were found sandy loam PH is 8.5 with low organic carbon (0.30 %). Most popular lentil variety was NDL 1 used and the gross plot size was 12 sq meters and all packages of practices were followed for conducting the experiment. This experiment was laid out in randomized block design with three replications. Observations were recorded from three plants in each plot. Plants were chosen diagonally. The data taken on weed control efficiency (%), weed dry weight (g/M2), grain yield (kg/ha), final Plant stand (000/ha), plant height (cm), number of pods per plant, number of seeds per pod and test weight (g) of each plot were recorded separately at harvesting stage. Threshing the harvested NDL 1 on tarpaulin followed by proper sun drying and winnowing, grain yield measured in kilogram. The data so obtain were subjected to statistical analysis after necessary transformation for final statistical analysis (Gomez and Gomez, 1983).

Results and Discussion

Yield and yield contributing traits

The yields contributing traits like final plant stand (000/ha), plant height (cm) number of pods per plant, number of seeds per pod and test weight (g) obtained from all treatments as well as control. Observation revealed that, plant height were high registered with treatment T_8-Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ weed management (WM)- pendimethalin@1kg

a.i./ha+one hand weeding at 30 DAS+pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water plot (34.5 cm) compare to control (27.3 cm), followed by treatment T_7-Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS in plant height of 32.8 cm. Number of pods per plant under treatment T_8-Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ weed management (WM)- pendimethalin @1kg a.i./ha+one hand weeding at 30 DAS+ pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water were recorded 79.8 pods per plant compare to control (36.9), followed by treatment of T_7- weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL in number of pods per plant (77.1) arepresented in table –1 & 2.This might be due to the efficient control of weeds by integrated weed management of herbicides. These findings are in concurrence with those of Dhonde *et al.,* (2009), Idupuganti *et al.,* (2005), Meena *et al.,* (2010), Singh and Sekhon (2013), Sharma *et al.,* (2014) and Murali *et al.,* (2013) and Rao *et al.*(2015).

There was significant difference among the treatments on yield. The data on different treatment is summarized in table 1. Treatment with Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+Pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water, highest grain yield of lentil 1433 kg/ha, yield increase 161.02%, followed by treatment of Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS grain yield of 1305 kg/ha and percentage increase of yield 137.70%, compare to control plot grain yield 549 kg/ha. In the plot treatment with T_5- Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS along with grain yield 1305 kg/ha and 137.70% increase grain yield over check was recorded. The plot treatment with weed management (WM)-pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS with yield 1013 kg/ha and increase grain yield 84.52 was recorded. The plot treatment with T_6- Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL with yield 834 kg/ha was recorded. In treatment of T_2- Nutrient management (NM)- RDF (20:17:16:20 kg NPKS/ha) along with grain yield 795 kg/ha was recorded. In the treatmentplot ofT_4- Pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water along with grain yield 701 kg/ha was recorded.

Economics

The inputs and outputs price of commodities prevailed during the experiment were taken for calculating cost of cultivation, net returns.

Table.1 Performance of lentil grin yield (kg/ha) as affected by under integrated crop management

Treatments	**Weed Control (%) efficiency at harvest**	**Weed dry weight in (g/M2)**	**Yield kg/ha**
T1- Control	-	77	549
T2- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)	46.08	47	795
T3- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS	67.48	31	1013
T4- Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water	38.87	53	701
T5- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS	77.87	20	1305
T6- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	47.29	44	834
T7- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	73.04	26	1177
T8- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	83.82	16	1433
SEM±	-	2.31	59.08
CD at (0.05%)	-	6.99	179.21
CV%	-	10.17	1059

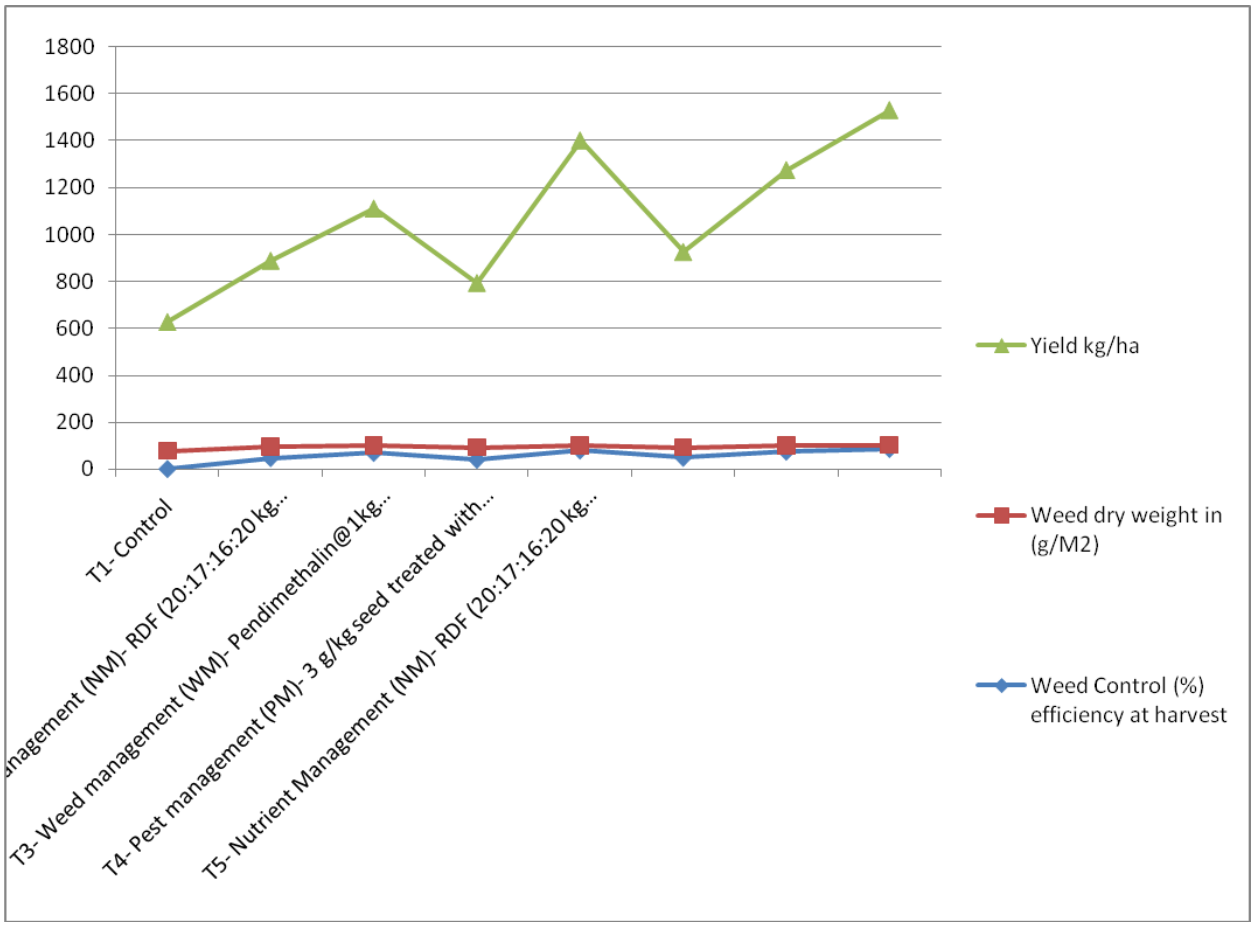
Table.2 Performance of lentil grain yield and yield contributing characters as affected by under integrated crop management

Treatments	Final plant stand (000/ha)	Plant Height (cm)	No of Pod/ plant	No of Seed/ pod	100 seed weight (g)
T1- Control	288	27.3	36.9	1.5	2.35
T2- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)	289	26.7	60.8	1.6	2.44
T3- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS	317	31.8	72.2	1.7	2.55
T4- Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water	292	27.7	54.6	1.6	2.43
T5- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS	308	32.8	75.5	1.8	2.54
T6- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	290	27.9	66.7	1.6	2.41
T7- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	322	32.2	77.1	1.8	2.49
T8- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	330	34.5	79.8	1.8	2.57

Table.3 Performance of economic as affected by under integrated crop management

Treatments	Gross expenditure (Rs./ha)	Sale price of grain (MSP) (Rs./qt)	Yield q/ha.	Gross returns (Rs./ha)	Extra returns over control	% increase over control
T1- Control	7000	1650	5.49	9059	-	-
T2- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)	9212	1650	7.95	13118	4059	44.80
T3- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS	12210	1650	10.13	16715	7656	84.52
T4- Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water	11250	1650	7.01	11567	2508	27.69
T5- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS	14290	1650	13.05	21533	12474	137.70
T6- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	13210	1650	8.34	13761	4702	51.91
T7- Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	24610	1650	11.77	19421	10362	114.38
T8- Nutrient Management (NM)- RDF (20:17:16:20 kg NPKS/ha)+ Weed management (WM)- Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+ Pest management (PM)- 3 g/kg seed treated with thirum 75%+Carbendazim 50% (2:1) and Monochrotophos 36% SL	16211	1650	14.33	23645	14586	161.02

Fig.1 Effect of integrated crop management on lentil grin yield (kg/ha), weed dry weight (g/M^2) and weed control efficacy.



The investment on production by adopting nutrient management (NM)-RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water highest grass returns of lentil Rs. 23645/ha, and extra returns of Rs. 14586/ha, followed by treatment of Nutrient management (NM)-RDF (20:17:16:20 kg NPKS/ha)+ weed management (WM)- pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS grass returns of Rs. 21533/-ha, and extra returns of Rs. 12474/-ha compared to control of Rs.9059/- presented in table 3. Similar results were collaborated with Singh *et al.*, (2014) and Raju *et al.*, (2015) findings.

In conclusion, all these treatments were found effective in the increase grain yield over untreated control. Nutrient management (NM)-RDF (20:17:16:20 kg NPKS/ha)+weed management (WM)-pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS+pest management (PM)- 3 g/kg seed treated with thirum 75%+carbendazim 50% (2:1) and monochrotophos 36% SL one litre per ha with spray 500 to 600 litre water increase grain yield over check, followed by Nutrient management (NM)- RDF (20:17:16:20 kg

NPKS/ha)+ weed management (WM)-Pendimethalin@1kg a.i./ha+one hand weeding at 30 DAS.

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