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Effect of Irrigation Schedules and Foliar Application of Potash on Yield and Yield Attributes of Summer Greengram (*Vigna radiata* L.)

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A B S T R A C T

An agronomic investigation was carried out at Post Graduate Institutional Research Farm, Mahatama Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra (India) during summer 2018 to study optimum irrigation schedule and the effect of foliar application of potash on growth, yield and quality of summer greengram . The experiment was laid out in split plot design with three replications. The experiment consists of twelve treatments involving four main plot treatments i.e. irrigation schedules at 40, 60, 80 and at 100 mm CPE and the subplot treatments are foliar application of 1 % potash (KNO_3) at flowering, at pod development stage and at flowering and pod development stage. The experimental results revealed that, the maximum consumptive use of water recorded under scheduling of irrigation at 40 mm CPE (305 mm), followed by treatment irrigation at 60 mm CPE (223 mm). Among the different treatments, irrigation at 40 mm CPE recorded significantly higher seed yield (13.31 q ha^{-1}) and yield attributes of summer greengram and it was at par with treatment irrigation at 60 mm CPE (13.08 q ha^{-1}). Foliar application of 1% potash (KNO_3) at flowering and at pod development stage recorded significantly higher seed yield (12.42 q ha^{-1}) and yield attributes of summer greengram. The study showed results the irrigation at 60 mm CPE and foliar application of 1% potash at flowering and pod development stage to summer greengram found suitable preposition to achieve highest grain yield.

Introduction

Pulses are commonly known as food legumes which are secondary to cereals in production and consumption in India and also an important source of dietary protein, energy, minerals and vitamins for the mankind. Pulses play an important role in Indian Agriculture as they restore soil fertility by fixing atmospheric nitrogen through their nodules. Pulses are also the main source of excellent nutritive forage and grain concentration of feeding the large cattle population. Soil fertility in terms of addition of organic matter and nitrogen fixation mediated by root nodule bacteria called *Rhizobium* is also important lunch of pulse crop. Among the pulses, greengram (*Vigna radiata* L.) is an ancient and well known leguminous crop of Asia, is a favourable one since it thrives better in all the seasons and it can be grown as a sole or inter crop or fallow crop. It is popular because of its nutritional quality having rich protein (23.86 %), carbohydrates (62.62 %), fat (1.15 %), minerals, amino acids, phosphoric acid, and vitamins. In Maharashtra, area under greengram cultivation is 6.71 lakh ha with a production of 3.71 lakh tonne and productivity of 552.91 kg ha^{-1} (Anonymous, 2016).

Indian soils are abundant in potassium, but their availability to crop is less. Potassium is one of the major essential plant nutrient acts as cofactor or activator for many enzymes of carbohydrates and protein metabolism. It plays an essential role in production and translocation of sugar. The increased production of starch and sugar in legumes fertilized with potash benefits the symbiotic bacteria and thus enhances the fixation of nitrogen. It enhances the ability of the plant to resist disease, insect attacks under adverse conditions. It helps in osmotic and ionic regulations.

Greengram, being a dryland crop, expected to respond well to K, as K plays an important role in water relations and water use efficiency and it is known to make the plant tolerant against extreme dry and wet season. Application of potash at the time of flowering reduces flower drop and at the time of pod development stage, it makes seed more shiny and enhances seed quality. The supply of nutrients through roots is restricted in some soil conditions such as salinity, high and low pH, sodicity etc. To overcome such problems, one such strategy may be foliar application of potassic sources of nutrients for exploiting genetic potential of the crop and to withstand the water stress condition. This is considered as an efficient and economic method of supplementing part of the nutrient requirements at critical stages. Nutrients play a important role in increasing the seed yield in pulses (Chandrashekhar and Bangaruswamy, 2014). Considering these points, the present investigation was studied to find out optimum irrigation schedule and the effect of foliar application of potash on growth, yield and quality of summer greengram.

Materials and Methods

The field investigation was conducted during summer season of 2018 at Post Graduate Institute Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra) which is situated between 19^0 18'N and 19^0 57'N latitude and 74^0 35'E and 74^0 19' E longitude. The soil of experimental field was loamy in texture (pH 8.1, EC 0.24 dSm^{-1} and organic carbon 0.43 %,) having field capacity, permanent wilting point and bulk density were 28.65 %, 14.48 % and 1.24 Mg m^{-3}, respectively. The available nitrogen, phosphorus and potassium in soil was 260.5, 19.78 and 470.74 kg ha^{-1} respectively. The experiment was laid down in split plot design consists of twelve treatment combinations with four main plot treatments (Irrigation schedules) *viz.*, I_1: irrigation at 40 mm CPE, I_2: irrigation at 60 mm CPE, I_3: irrigation at 80 mm CPE and I_4: irrigation at 100 mm CPE and three sub-plot treatments (Foliar application of 1% potash at different growth stages), i.e. F_1: at flowering stage, F_2: at pod development stage and F_3: at flowering and pod development stage. For sowing of summer greengram, the *Vaibhav* variety with 15-20 kg ha^{-1} seed rate was used. Basal dose of fertilizer 20:40:0 NPK kg ha^{-1} was applied to all plots. Among the irrigation regimes, irrigation was applied at 40, 60, 80 and 100 mm CPE with 5 cm depth at each irrigation turn of three treatments, respectively. At each irrigation turn measured quantity of irrigation water was applied with the help of 90^0 V notch weir, fixed at plot head. The discharge was calculated by using following formula Michael *et al.,* (1977).

$$Q = 0.0138\ H^{5/2}$$

Where,

Q	=	Discharge (Lit. Sec^{-1})
H	=	Head (cm)

All the plant protection measures were adopted to take healthy crop at maturity stage, after leaving two rows on each side, a net plot area was harvested separately for recording the yield attributing parameters. The harvested material was tied and tagged and kept on threshing floor sun drying. Different yield attributes *viz*., cluster $plant^{-1}$, pod $plant^{-1}$, pod length, wt. of 1000 grains, seeds pod^{-1}, seed yield and straw yield were reported at the time of maturity of the crop.

Results and Discussion

Yield contributing characters

Effect of irrigation schedules

The number of clusters $plant^{-1}$, number of pods $plant^{-1}$, length of pod, number of seeds pod^{-1}, seed weight $plant^{-1}$, and 1000 seed weight were influenced significantly due to the different irrigation schedules. Irrigation at 40 mm CPE recorded significantly higher number of clusters $plant^{-1}$ (4.02), number of pods $plant^{-1}$ (17.40), length of pod (8.97 cm), number of seeds pod^{-1} (9.84), seed weight $plant^{-1}$ (4.88 g), and also 1000 grain weight (50.50 g) than any other treatments, followed by treatment irrigation at 60 mm CPE in all yield contributing characters during summer season of the year. Optimum irrigation water resulted in vigorous growth of crop during its vegetative and reproductive phase and resulted in higher production of cluster $plant^{-1}$, number of pods $plant^{-1}$, length of pod. These results are same as reported by Arya and Sharma (1996), Yadav and Singh (2014) and Singh *et al.,* (2018).

Regarding the number of seeds pod^{-1}, the more number of seeds pod^{-1} recorded under irrigation treatment at 40 mm CPE and 60 mm CPE due to more number of irrigation causes delayed maturity as compared to other irrigation schedules and thus more time for partitioning of assimilates to seeds. These results were similar to those reported by Patidar and Singh (1994) and Navneet Kaur (2014). The higher 1000 grain weight might be due to the fact that frequently applied irrigations led to higher accumulation and higher number of filled seeds that ultimately increased test weight of grains. Navneet Kaur (2014) and Behera *et al.,* (2015) also observed similar trends in test weight due to irrigation scheduling.

Effect of foliar application of 1% potash at different growth stages

The number of clusters $plant^{-1}$, number of pods $plant^{-1}$, length of pod, number of seeds pod-1, seed weight $plant^{-1}$, and test weight were influenced significantly due to foliar application of 1% potash at different growth stages.

Foliar application of 1% potash at pod development stage recorded significantly higher number of clusters $plant^{-1}$ (3.81), number of pods $plant^{-1}$ (15.72), length of pod (8.32 cm), number of seeds pod^{-1} (9.16), seed weight $plant^{-1}$ (4.46 g), and also 1000 grain weight (48.70 g) than rest of other treatments. The foliar applications of potash at flowering and pod development stage might have reduced flower drop. This might have significantly increased the clusters $plant^{-1}$. These results also resembles the findings of

Ganapathy *et al.,* (2008). Regarding the seed weight plant^{-1}, foliar application of 1% potassium had the greatest stimulatory effect on number of pods plant^{-1}, dry weight of pods plant^{-1}, number of seeds pod^{-1} and seed index which ultimately increased the seed weight plant^{-1}.The obtained result are in full agreement with the findings of Kassab (2005).

Interaction

The interaction effect between irrigation schedules and foliar application of 1% potash at different growth stages on number of pods plant^{-1} and 1000 seed weight found significant. However, it was found non-significant in case of number of clusters plant^{-1}, length of pod, number of seeds pod^{-1} and seed weight plant^{-1} clusters plant^{-1}of summer greengram.

Grain and haulm yield

The grain and haulm yield of summer green gram as influenced by different irrigation schedules and foliar application of 1% potash at different growth stages are presented in Table 2 and depicted in Fig. 2.

Effect of irrigation schedules

The grain and haulm yield were influenced significantly due to the different irrigation schedules. Irrigation at 40 mm CPE recorded significantly maximum grain yield (13.31 q ha^{-1}) than rest of all other treatments. However, it was at par with treatment irrigation at 60 mm CPE (13.08 q ha^{-1}) during summer season of the year. Significantly minimum grain yield was found in treatment irrigation at 100 mm CPE (9.82 q ha^{-1}).

The highest grain yield recorded under irrigation treatment at 40 mm CPE. This indicates that seed yield increased with increase in irrigation frequency.

The highest seed yield obtained under irrigation schedule at 40 mm CPE resulted from the cumulative effect of higher number of pods plant^{-1}, seeds pod^{-1} and test weight compared to other irrigation schedules. Prajapati *et al.,* (2006) and Yadav and Singh (2014) also observed similar trend in grain yield with different irrigation schedules.

The highest haulm yield recorded under irrigation treatment at 40 mm CPE. The reason for increased haulm yield under more frequently irrigated regimes might be due to more efficient photosynthesis as the evapo-transpirational demands were fulfilled better under more water availability and the plants produced more dry matter and leaf area and ultimately found higher haulm yield. These results are in consonance with the findings of Parmar and Thanki (2007) and Idnani and Gautam (2008).

Foliar application of 1% potash at different growth stages

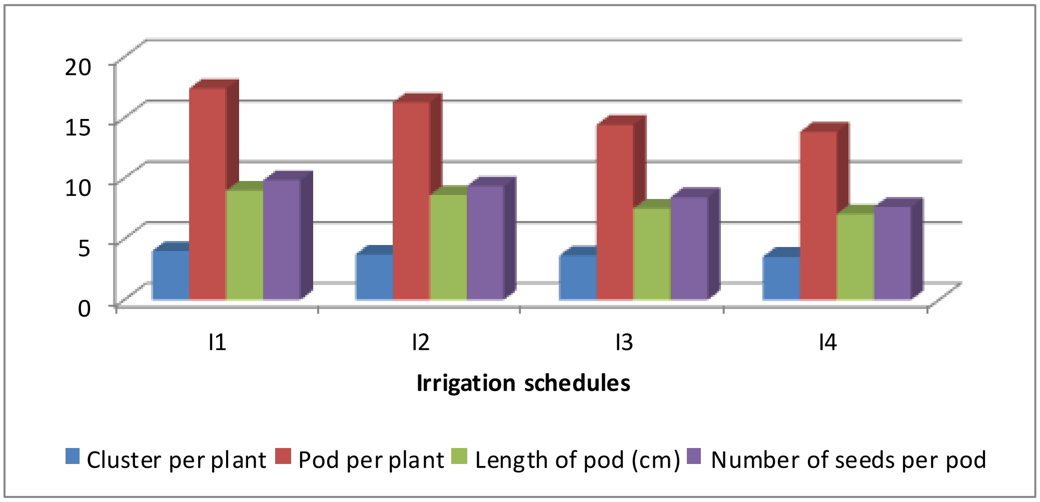
The grain and haulm yield of summer green gram were influenced significantly due to foliar application of 1% potash at different growth stages. Significantly, the maximum grain yield was obtained when foliar application of potash at flowering and pod development stage (12.42 q ha^{-1}). Foliar spray of potash had the greatest stimulatory effect on moisture stress at different stages of growth significantly number of pods plant^{-1}, dry weight of pod, number of seeds increased the seed protein content. However, number of seeds pod^{-1}, dry matter plant^{-1}andtest weight of seeds ultimately increases the grain yield of summer greengram. Similar results were observed by Lakshmi *et al.,* (2018) and Thanunathan *et al.,* (2018). Significantly, the maximum haulm yield (24.31 q ha^{-1}) was obtained when foliar application of 1% potash at flowering and pod development stage.

Table.1 Yield contributing characteristics as influenced by different treatments

Treatment	Yield contributing characters					
	No. of clusters plant^{-1}	No. of pods plant^{-1}	Length of pod (cm)	No. of seeds pod^{-1}	Seed weight plant^{-1} (g)	1000 grains wt (g)
A.Irrigation Schedules (I)						
I_1 - 40 mm CPE	4.02	17.40	8.97	9.84	4.88	50.50
I_2 - 60 mm CPE	3.73	16.24	8.60	9.34	4.64	49.52
I_3 - 80 mm CPE	3.64	14.42	7.51	8.43	3.89	47.52
I_4 - 100 mm CPE	3.54	13.84	7.06	7.63	3.33	45.50
S.Em. ±	0.02	0.03	0.09	0.17	0.01	0.01
C.D. at 5%	0.08	0.10	0.33	0.57	0.05	0.03
B. Foliar application of 1 % potash at different growth stages (F)						
F_1 - At flowering	3.67	15.33	7.90	8.58	3.90	47.99
F_2 - At pod development	3.71	15.37	7.89	8.70	4.20	48.09
F_3 - At flowering and pod development	3.81	15.72	8.32	9.16	4.46	48.70
S.Em. ±	0.03	0.02	0.092	0.09	0.01	0.01
C.D. at 5%	0.10	0.06	0.27	0.29	0.04	0.03
C. Interaction (I x F)						
S.Em. ±	0.07	0.04	0.18	0.19	0.03	0.02
C.D. at 5%	NS	Sig.	NS	NS	Sig.	NS
General mean	**3.73**	**15.47**	**8.03**	**8.81**	**4.19**	**48.26**

Table.2 Grain and haulm yield as influenced by different treatments

Treatment	Grain yield (q ha^{-1})	Haulm yield (q ha^{-1})
A. Irrigation Schedules (I)		
I_1 - 40 mm CPE	13.31	25.47
I_2 - 60 mm CPE	13.08	24.98
I_3 - 80 mm CPE	11.79	24.28
I_4 - 100 mm CPE	9.82	18.93
S.Em. ±	0.23	0.34
C.D. at 5%	0.79	1.18
B. Foliar application of 1 % potash at different growth stages (F)		
F_1 - At flowering	11.71	22.81
F_2 - At pod development	11.88	23.13
F_3 - At flowering and pod development	12.42	24.31
S.Em. ±	0.12	0.33
C.D. at 5%	0.37	1.00
C. Interaction (I x F)		
S.Em. ±	0.24	0.67
C.D. at 5%	NS	NS
General mean	**12.00**	**23.41**



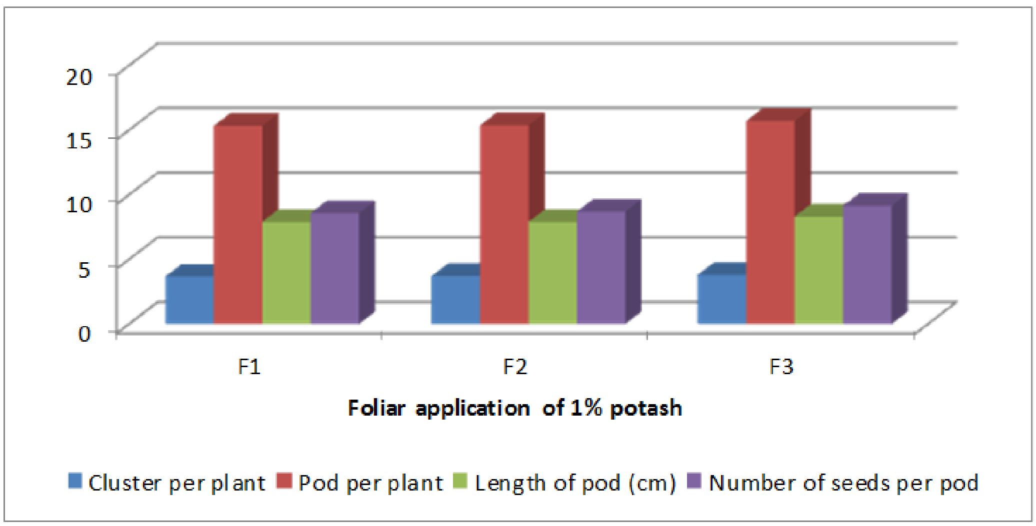
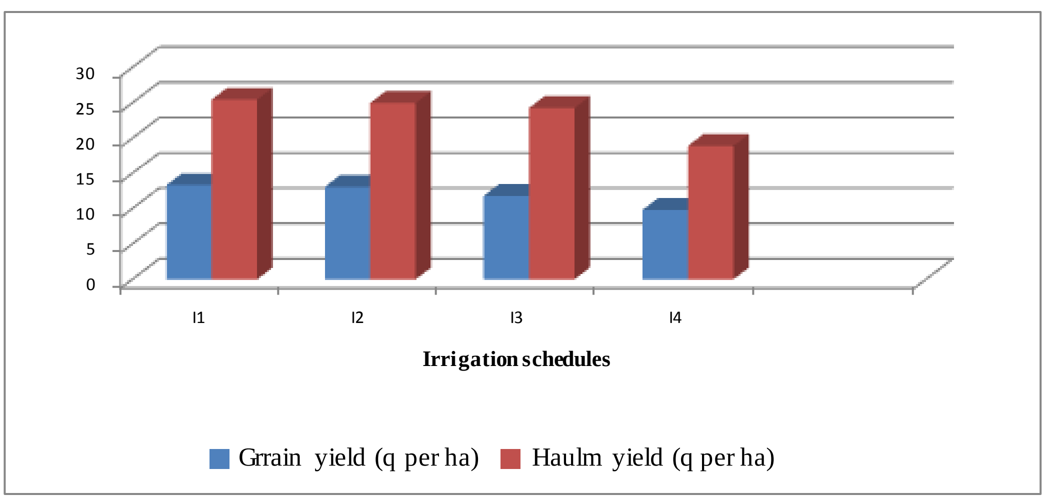


Fig.1 Effect of irrigation schedules and foliar application of potash on yield contributing characters of summer greengram



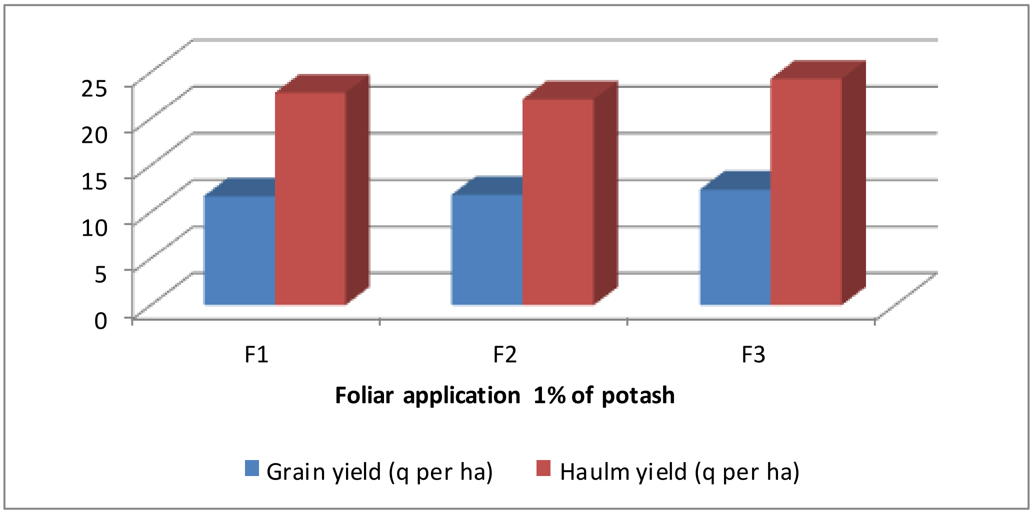


Fig.2 Effect of irrigation schedules and foliar application of potash on grain and haulm yield of summer greengram

Interaction

The interaction effect between irrigation schedules and foliar application of 1% potash at different growth stages on grain and haulm yield of summer green gram was found non-significant.

On the basis of one year experiment, it could be concluded that, the irrigation at 60 mm CPE and foliar application of 1% potash at flowering and pod development stage to summer green gram found suitable preposition to achieve highest grain yield.

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