Research Article

Effect of Potash on Physiochemical Properties of Summer Green Gram at Different Irrigation Schedules

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Abstract

A field experiment was conducted to study the effect of scheduling of irrigation and foliar spray of potash on yield and physiochemical studies of summer greengram at PGI Research Farm, MPKV, Rahuri, Dist. Ahmednagar, Maharashtra during summer 2018. The experiment was carried out in split plot design with three replications and twelve treatments consist of four main plot treatments i.e. scheduling of irrigation at 40, 60, 80 and at 100 mm CPE and three sub plot treatments i.e. foliar spray of 1 % potash (KNO_3) at flowering, at pod development stage and at flowering and pod development stage. The experimental results revealed that, irrigation schedule at 40 mm CPE showed significantly higher seed yield (13.31 q ha^{-1}) and it was found at par with irrigation schedule at 60 mm CPE (13.08 q ha^{-1}). Foliar spray of 1% potash (KNO_3) at flowering and at pod development stage showed significantly higher seed yield (12.42 q ha^{-1}) of summer green gram. Regarding physiochemical studies the results revealed that irrigation at 40 mm CPE exhibited significantly higher photosynthetic rate, transpiration rate and stomatal conductance followed by irrigation at 60 mm CPE in respect to photosynthetic rate, transpiration rate and stomatal conductance at 30 and 45 DAS respectively. Whereas, irrigation at 100 mm CPE exhibited significantly maximum stomatal resistance and leaf temperature at 30 and 45 DAS, respectively. Foliar spray of 1 % potash at flowering and pod development stage showed maximum photosynthetic rate, transpiration rate and stomatal conductance at 30 and 45 DAS. Whereas, foliar spray of 1 % potash at pod development stage exhibited maximum stomatal resistance and leaf temperature at 30 and 45 DAS during summer season of crop.

Keywords: Green gram, Irrigation schedules, Foliar spray and Physiochemical properties

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Introduction

Pulses occupy a distinctive place in Indian agriculture because they are the excellent source of vegetable protein to the Indian diet. In addition to being a high source of protein, soil fertility is maintained through biological atmospheric nitrogen fixation in soil and therefore plays an important role in sustainable development. Among the pulses green gram (*Vigna radiata* L.) is a well known and ancient leguminous crop. It is popular due to its nutritional quality having high protein content (23.86 %), carbohydrates (62.62 %), fat (1.15 %), minerals, amino acids, orthophosphoric acid and vitamins. The yield potential of mung is low due to various fact that, the crop is especially grown in rainfed conditions with poor management practices and also because of various physiological, biochemical as well as inherent factors related to crop. The cultivation period of summer greengram is from mid march to end June. During this period, water loss through evaporation accounts for 50 % of the normal water loss for the whole year. The irrigation requirement of summer greengram becomes very high due to high evapotranspiration rate. Indian soils are abundant in potassium, it plays an essential role in production and translocation of sugar. It enhances nitrogen fixation by increasing sugar and starch production in legumes fertilized with potash ultimately increases the symbiotic bacteria. It helps in osmotic and ionic regulations. Nutrients play an important role to increase the seed yield of pulses [1].

The stomata of the plants are the most important gate between atmosphere and plant, so it plays a key role in plant responses to different environmental conditions [2]. Under drought conditions, the relative magnitude of stomatal factors which limits photosynthesis depends upon the duration and degree of exposure, its intensity and crop growth stage [3]. Drought experiencing plants exhibit low stomatal conductance for conserving water inside the cell. As a result, the fixation of CO_2 is reduced and the rate of photosynthesis decreases, which results lowering down the production of assimilates for growth and yield [4].

Considering these points, the present investigation was formulated and studied.

Material and Methods

The field investigation was conducted during summer 2018 at Post Graduate Institute Research Farm, MPKV, Rahuri (Maharashtra) which is located 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 %,). The experiment was carried out in split plot design with three replications and twelve treatments comprised of four main plot treatments i.e. scheduling of irrigation at 40, 60, 80 and at 100 mm CPE and three subplot treatments i.e. foliar spray of 1 % potash (KNO_3) at flowering, at pod development stage and at flowering and pod development stage. For sowing of summer green gram, the *Vaibhav* variety with 15-20 kg ha^{-1} seed rate was used. The basal dose of fertilizer was applied @ 20:40:0 NPK kg ha^{-1} to all plots. Physiological parameters *viz.*, photosynthetic rate, stomatal conductance, transpiration rate, stomatal resistance, and leaf temperature were recorded using Infra-Red Gas Analyzer (IRGA) LI-COR make LI 6400XT periodically at 30 and 45 days after sowing [5].

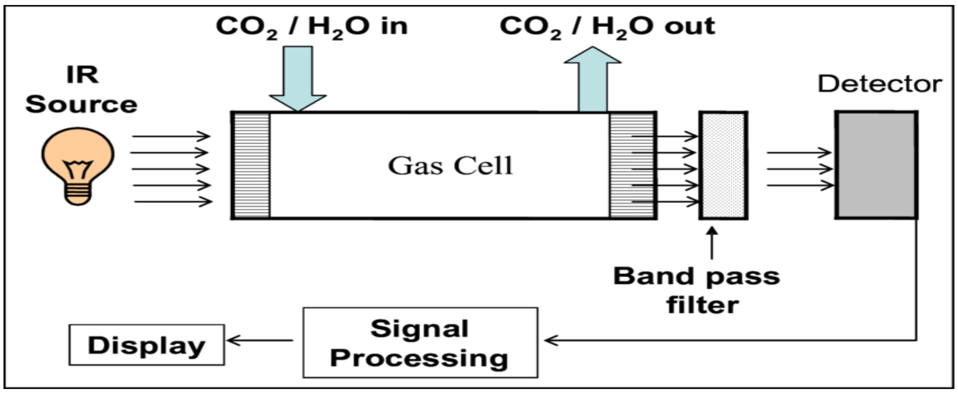

Figure 1 Infra Red Gas Analyzer [6]

Infra-Red Gas Analyzer (IRGA) LI-COR make LI 6400XT is a system which suggests that the photosynthesis measurement is depends upon the differences in CO_2 and H_2O concentration in a stream which flows through the leaf cuvette. The physiochemical observations were taken by selecting five randomly tagged plants on the middle, lower and upper leaves and then averaged for per plant and these were recorded between 10-11 am at every time [7].

Results and Discussion

Grain yield

The grain yield of summer greengram as affected by different irrigation schedules and foliar spray of 1% potash at different growth stages are presented in **Table 1**.

Table 1 Grain yield of summer green gram as affected by different treatments

Treatment	Grain yield (q ha^{-1})
A. Irrigation Schedules (I)	
I_1 - 40 mm CPE	13.31
I_2 - 60 mm CPE	13.08
I_3 - 80 mm CPE	11.79
I_4 - 100 mm CPE	9.82
S.Em. $\pm$	0.23
C.D. at 5%	0.79
B. Foliar spray of 1 % potash at different growth stages (F)	
F_1 - At flowering	11.71
F_2 - At pod development	11.88
F_3 - At flowering and pod Development	12.42
S.Em. $\pm$	0.12
C.D. at 5%	0.37
C. Interaction (I x F)	
S.Em. $\pm$	0.24
C.D. at 5%	NS
General mean	12.00

Effect of Irrigation schedules

The grain yields were affected significantly due to the different irrigation schedules. Irrigation at 40 mm CPE showed significantly maximum grain yield (13.31 q ha^{-1}) than rest of all other treatments. However, it was found at par with scheduling of 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 collective effect of higher no. of pods $plant^{-1}$, no. of seeds pod^{-1} and test weight compared to other irrigation schedules [8, 9].

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

The grain yield of summer greengram was influenced significantly due to foliar spray of 1% potash at different growth stages. Significantly, the maximum grain yield was obtained when foliar spray of potash at flowering and pod development stage (12.42 q ha^{-1}). Foliar spray of potash had the maximum stimulatory effect on moisture stress at different growth stages significantly no. of pods $plant^{-1}$, dry weight of pod, no. of seeds increased the protein content in seed. However, no. of seeds pod^{-1}, dry matter $plant^{-1}$ and test weight of seeds ultimately increases the grain yield of summer green gram [10, 11].

Interaction

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

Physiochemical studies

Effect of irrigation schedules

Data presented in **Table 2** indicated the significant effect of scheduling of irrigation on photosynthetic rate, transpiration rate, stomatal conductance, stomatal resistance and leaf temperature in leaves of summer green gram. Irrigation at 40 mm CPE exhibited significantly higher photosynthetic rate (8.42 and 19.25 µ mol CO_2 m^{-2} s^{-1}), transpiration rate (6.20 and 8.73 m mol H_2O m^{-2} s^{-1}) and stomatal conductance (0.54 and 0.74 m mol m^{-2} s^{-1}) followed by irrigation at 60 mm CPE, i.e. photosynthetic rate (8.16 and 19.08 µ mol CO_2 m^{-2} s^{-1}), transpiration rate (5.92 and 8.59 m mol H_2O m^{-2} s^{-1}) and stomatal conductance (0.53 and 0.73 m mol m^{-2} s^{-1}) at 30 and 45 DAS. Whereas, irrigation schedule at 100 mm CPE exhibited significantly maximum stomatal resistance (4.32 and 3.06 m mol m^{-2} s^{-1}) and leaf temperature (36.96 and 35.50 ^{0}C) at 30 and 45 DAS during summer season of the year.

This might be because of Irrigation at 40 mm CPE promote profuse vegetative growth, profuse foliage and growth of the plant leads to increase biomass of the crop above ground level which absorbed more diffused radiation causing more absorption of photo synthetically active radiation (APAR) resulted in more photosynthesis [12]. Irrigation level at 40 mm registered optimum amount of moisture availability in root zone of summer green gram plant leads to more vegetative growth which increased the light interception which resulted in increased stomatal conductance [13, 14]. Lesser foliar growth due to less availability of water in root zone, intercept less photosynthetic active radiation in deficit irrigation and crop introduce moisture conservation mechanism resulted into partial closure of stomata and guard cell offer more resistance to reduce transpiration [15]. Irrigation at 100 mm CPE show lower air humidity, higher atmospheric temperature and higher CO_2 concentration around crop resulted in to warming effect surrounding the crop [16].

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

Foliar spray of potash at flowering and pod development stage exhibited maximum photosynthetic rate (8.05 and 18.84 µ mol CO_2 m^{-2} s^{-1}), transpiration rate (5.83 and 8.17 m mol H_2O m^{-2} s^{-1}) and stomatal conductance (0.53 and 0.71m mol m^{-2} s^{-1}) at 30 and 45 DAS. Whereas, foliar spray of 1 % potash at pod development stage exhibited maximum stomatal resistance (4.21 and 2.89 m mol m^{-2} s^{-1}) and leaf temperature (35.93 and 34.26 ^{0}C) at 30 and 45 DAS during summer season of the year (Table 2).

Interaction

The interaction effect between irrigation schedules and foliar spray of 1% potash at different growth stages on photosynthetic rate, transpiration rate, stomatal conductance, stomatal resistance and leaf temperature of summer green gram leave was found non significant

Table 2 Periodical photosynthetic rate, stomatal conductance, transpiration rate, stomatal resistance and leaf temperature of summer green gram as influenced by different treatments

Treatment	Photosynthetic rate (μ mol CO_2 m^{-2} s^{-1})		Stomatal conductance (m mol m^{-2} s^{-1})		Transpiration rate (m mol H_2O m^{-2} s^{-1})		Stomatal resistance (m mol m^{-2} s^{-1})		Leaf temperature (^0C)	
	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS	30 DAS	45 DAS
A. Irrigation Schedules (I)										
I_1 - 40 mm CPE	8.42	19.25	0.54	0.74	6.20	8.73	3.78	2.50	32.73	31.44
I_2 - 60 mm CPE	8.16	19.08	0.53	0.73	5.92	8.59	4.10	2.67	34.88	33.41
I_3 - 80 mm CPE	7.86	18.55	0.52	0.69	5.55	7.67	4.21	2.87	35.99	34.32
I_4 - 100 mm CPE	7.44	18.14	0.48	0.67	5.39	7.38	4.32	3.06	36.96	35.50
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.02	0.15	0.05
C.D. at 5%	0.02	0.04	0.01	0.01	0.02	0.02	0.15	0.05	0.48	0.18
B. Foliar spray of 1 % potash at different growth stages (F)										
F_1 - At flowering	7.98	18.76	0.52	0.71	5.78	8.09	4.08	2.77	35.22	33.62
F_2 - At pod development	7.88	18.66	0.51	0.70	5.69	8.02	4.21	2.89	35.93	34.26
F_3 - At flowering and pod development	8.05	18.84	0.53	0.71	5.83	8.17	4.01	2.68	34.28	33.13
S.Em. ±	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.14	0.11
C.D. at 5%	0.02	0.02	0.01	0.01	0.03	0.02	0.11	0.04	0.41	0.33
C. Interaction (I x F)										
S.Em. ±	0.01	0.01	0.01	0.01	0.02	0.01	0.07	0.02	0.27	0.22
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	7.97	18.75	0.52	0.71	5.77	8.09	4.10	2.78	35.14	33.67

Conclusion

It is inferred that the scheduling of irrigation at 60 mm CPE and foliar spray of 1% potash at flowering and pod development stage to summer green gram found suitable preposition to achieve higher grain yield as well as higher photosynthetic rate, transpiration rate, stomatal conductance and minimum stomatal resistance and leaf temperature.

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