Effect of foliar potassic application and irrigation levels growth, yield and nutrient content of mungbean

Abstract

A field experiment was conducted during 2018 to study the Response of *Summer* Mungbean (*Vigna radiata* L. Wilczek) to Foliar Potassic Fertilization under Different Moisture Regimes during the *summer* season of 2018 at Technology Park of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.). Results revealed that the growth parameters of mungbean *viz.*, plant height, plant spread, number of leaves/plant, LAI, dry matter accumulation/plant, and grain yield were significantly higher under 0.6 IW/CPE ratio as compared to 0.4 IW/CPE ratio. Nutrient content (N, P and K) was also found higher under 0.6 IW/CPE ratio than 0.4 IW/CPE ratio. Among potassium treatments, foliar application of 1%K through KNO_3/KCl at flowering and pod development stage produced significantly higher values of growth parameters *viz.*, plant height, number of leaves and branches/plant and dry matter accumulation/plant at all the stages of growth except at 25 DAS. Foliar application of 1%K through KNO_3/KCl at flowering and pod development stage recorded significantly higher grain and straw yield than rest of the treatments. Nutrient content was found higher under foliar application of 1%K through KNO_3/KCl at flowering and pod development stage, but did not differ significantly.

Key words: *Summer* mungbean, KCl, KNO_3, foliar spray, 0.4 and 0.6 IW/CPE ratio.

Introduction

Pulses are wonderful gift of nature. They can be grown on wide range of climatic condition and soils. Pulses are rich in protein and are regarded as main protein source for vegetarians. Pulses are considered as the second major constituent of Indian diet after cereals. Pulses besides enriching the soil by fixing atmospheric nitrogen and improve the organic matter into the soil. Pulses are also used as green manuring crops. Besides enriching the soil nutrient status and physical structure, pulses also suit well in mixed cropping, intercropping, crop rotation and dry farming. They are the nutritional source for humans and cattle as well, thereby contributing to a more sustainable food system. On an average, pulses contain 22-25% protein as against 8-10% in cereals. Total acreage under pulses in the world is about 85.4 million ha with annual production of 87.4 million tonnes and productivity of 1023 kg ha^{-1}. India ranks first in area and production of pulses with 34% and 26% of world, respectively. In India, pulses were cultivated in more than 27.9 million ha of area with a production of 23.0

million tonnes at an average productivity of 823 kg ha^{-1} [1]. Main pulse producing states in India are Rajasthan, Madhya Pradesh, Maharashtra, Karnataka and Uttar Pradesh. Rajasthan being the leading producer of pulses accounts for about 6.34 million ha of area with a production of 4.50 million tonnes at an average productivity of 709 kg ha^{-1}. The lower productivity in Rajasthan than the national average was due to only 23.3 % of total pulse cultivated area is under irrigated condition [1].

Among pulses, Mungbean can be grown as catch crop because of its short growth period. In *summer* due to high temperature, high transpiration rate and low water availability, moisture stress occurs at various growth stages. Drought stress occurs when the water near the root surface is not sufficient for absorption. As the soil dries up, rhizobium population decreases radically immediately [2]. As the moisture stress increases, it drastically reduces the nitrogen fixation along with plant growth [3]. Among the tools of crop production, irrigation became the most important factor in the changing global scenario. Day by day the requirement of water during *summer* months is increasing due to high temperature and higher evapotranspiration needs [4]. Adequate water is required at all growth stages of mungbean crop but they are very much susceptible to water stress during flowering and pod filling stage. Shortage of water during these sensitive stages will cause significant reduction in yield. Water stress negatively affects many plant processes including photosynthesis, transpiration, evaporation [5] etc. which also cause substantial reduction in dry matter accumulation [6]. Efficient use of water during *summer* will help in enhancing the production, productivity of pulses, water productivity and water use efficiency. Scheduling of irrigation is the major factor which plays a key role in producing higher yields of *summer* crop. Therefore, scheduling of irrigation in a scientific manner will improve the water use efficiency and reduce the water losses. Irrigation water economy can be aimed through scheduling of irrigation at right time and meteorological approach based pan evaporation is one of the simplest, reliable and economical method.

Crop management practices can include both by applying fertilizer through soil and as well as on foliage. However, foliar application of nutrients to pulses is in limited use currently for increase of stress resistance mechanism. There is no time for basal application of nutrients to pulses when grown as relay cropping, where pulses are sown prior to harvest of first crop, so basal application of nutrients to pulses become impossible. Balusamy and meyyazhagan [7] suggested that foliar application of nutrients was more appropriate, efficient and economical than soil application. Application of nutrients on foliage at proper stages of crop growth plays an important role in utilization of nutrients and better performance of the crop [8]. Generally, Indian soils are rich in potassium but its availability to crops is low and not sufficient. In India, now a days intensive cropping and intercropping are gaining importance and high yielding varieties responds positively to different levels of potassium doses. Macro nutrients play a key role in boosting the grain yield in pulses. Foliar treatment of macronutrients like nitrogen and potassium was found as effective as soil application [9]. Potassium is one of the macronutrient which plays a major role in plant growth and sustainable crop production. It involves in more than 60 plant enzymes activation [10]. It imparts resistance in plants against diseases and pests attack. It also helps in maintaining the turgor pressure of the cell which is necessary for cell expansion. It also helps in osmo-regulation of plant cell, support in opening and closing mechanism of stomata [11]. Taken as whole, potassium is an enzyme activator, helps in synthesis of starch and protein, helps in metabolism, plays major role in stomatal regulation, also takes part in chlorophyll formation and grain development. It provides strength to stem and imparts resistance against lodging. Potassium (K^+) is reported as an important element in reducing the ill effects of soil water stress. Potassium stimulates root growth hence explores the more soil water. Therefore, there is very much essential to give potassium nutrition externally to enhance overall plant growth and plant productivity. Application of potassium in the course of vegetative and reproductive stages can reduce the ill effects of water stress. Thalooth *et al.* [12] reported that foliar application of potassium improves the water content in the broad bean leaves. Foliar application of potassium increases the drought tolerance in mungbean plant [13]. Application of potassium at the time of flowering showed the beneficial effect on all the growth characters [14].

Hence, considering the above facts, the research was planned to study the effect of foliar potassium application and irrigation regimes on mungbean crop.

Materials and methods

The field experiment was conducted at Technology Park, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.), located at a latitude of 29^0 4’ North and longitude of 77^0 42’ East with an elevation of 228 meter above the mean sea level. It comes in semi-arid and sub-tropical climatic zone. The *summers* are too hot and dry while winters are too cold. Moderate rainfall and wide temperature variation are the characteristic features of the semi-arid and sub-tropical climate. *Summers* last from early April to late June. The mean minimum temperature reached as low as 3^0C in winters, while during *summer* the mean maximum temperature varies from 43-45^0C in May.

Weekly data on mean temperature, relative humidity and total rainfall recorded during the crop season i.e., *summer* season 2018, at the meteorological observatory located at the Sardar Vallabhbhai Patel University of Agriculture and technology, Meerut (U.P.) is depicted in Fig 1. The mean weekly lowest and highest temperature recorded during the crop growth period were 14.3^{0}C and 44.6^{0}C, respectively. Data showed that average maximum weekly temperature ranged between 32.3^{0}C in March to 44.6^{0}C in May, while average minimum weekly temperature ranged between 14.3^{0}C to 26.3^{0}C. The total amount of rainfall received during crop period was 74.5 mm. The maximum and minimum mean weekly pan evaporation during crop growth period was 12.57 and 3.77 mm, respectively.

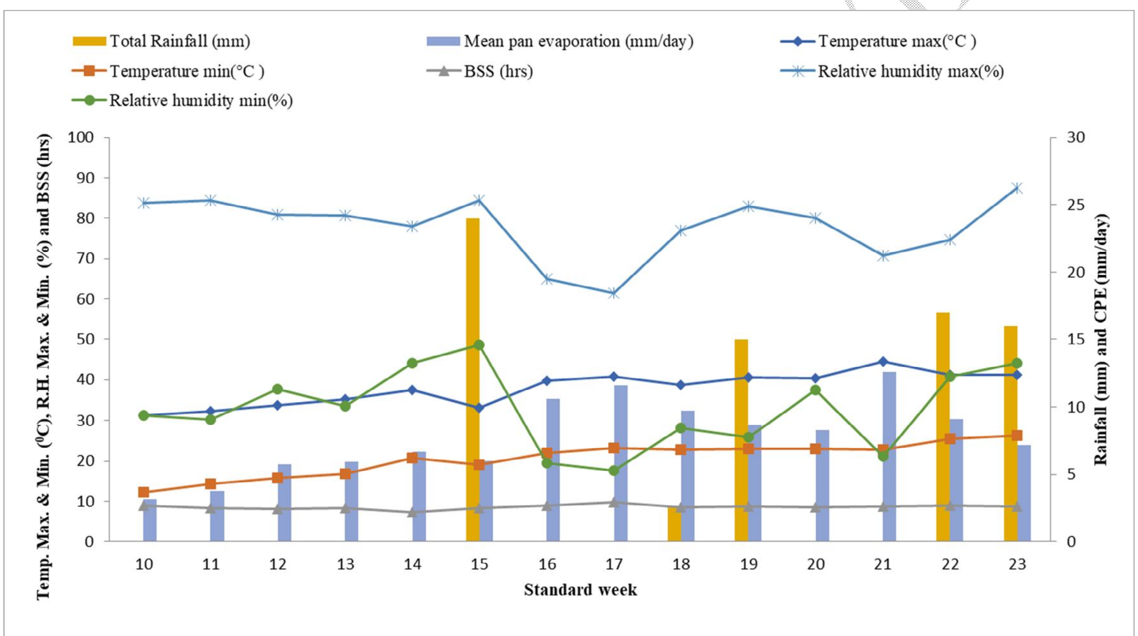

Fig. 1: Mean weekly weather data during crop period (2018)

Treatments were formulated as to ensure the possible and feasible solution to the issues occurs due to water stress condition during the *summer*, especially in pulse production. The experiment was laid out in Split plot design by having 12 treatment combination comprising two irrigation levels in main plot and 5 foliar potassium sprays along with control in sub plots which were replicated thrice. The soil of the experimental field was sandy loam in texture and soil was medium in available phosphorus and available potassium but low in organic carbon and available nitrogen.

S. No.	Symbol	Treatments

A. Main plots: Irrigation schedules (IW/CPE) (2)		
1	I_1	0.6
2	I_2	0.4
B. Sub plots: Foliar potassium application (6)		
1	T_1	water spray
2	T_2	1%K by KCl at flowering
3	T_3	1%K by KNO_3 at flowering
4	T_4	1%K by (KCl+KNO_3) at flowering
5	T_5	1%K by KCl at flowering and pod development
6	T_6	1%K by KNO_3 at flowering and pod development

Treatment imposition

Irrigation: One pre-sowing irrigation was given before land preparation especially to provide sufficient moisture for land preparation and later irrigations were given based on climatological approach, at IW/CPE ratio of 0.6 and 0.4, as per treatments. The evaporation was recorded every day from USWB (United States Weather Bureau) Class A open pan evaporimeter installed at IIFSR, Modipuram. In totality five irrigations were scheduled to the treatment with 0.6 IW/CPE (on 6th April, 22nd April, 2nd May,19th May and 28th May) and 3 irrigations were scheduled to the treatment with 0.4 IW/CPE ratio (on 16th April, 2nd May and 24st May).

Foliar potassium application: Recommended dose of fertilizer was applied @ 20 kg N/ha and 40 kg P_2O_5/ha to all the treatments. The whole amount of nitrogen and phosphorous were given through DAP (18% N and 46% P_2O_5) and urea (46%) as basal dose i.e., at the time of sowing and foliar potassium fertilizers were given as per treatments to each plot.

Results and discussion

Plant population at harvest

Irrigation schedules had brought significant difference in plant population of mungbean at maturity. Plant population of mungbean at maturity increased with increasing the number of irrigations. Significantly higher plant population at maturity and significantly lower mortality (10.1 %) was noticed under 0.6 IW/CPE irrigation level than 0.4 IW/CPE ratio. Highest plant population might be due to adequate moisture supply during the entire crop growth, which improves the root system and maintains water status in plant cells. Lowest plant population and highest mortality (%) was recorded under 0.4 IW/CPE ratio irrigation schedule which might be due to the fact that plants have undergone moisture stress for some period of life cycle and thus adversely affected the plant stand. The results are in confirmation to the findings of Kanubhai [15] and Chaudhary *et al.* [16].

Plant population of mungbean at maturity also increased with increasing the number of potassium sprays. Highest plant population (298700 plants/ha) and lowest mortality (9.3 %) was recorded with the application of 1%K through KNO_3 spray at flowering and pod development and lowest plant population was recorded under water spray (284800 plants/ha) though the difference between treatments was not significant. The higher plant population in potassium applied plots than control might be due to major role of potassium in the transport of water and nutrients, besides maintaining the water potential in the plant cells which could be helpful in higher plant stand at harvest. Our results are in close proximity with Marskole [17] in soybean.

Growth and Developmental Studies

Effect of irrigation regimes on growth of mungbean

The data with respect of plant height, plant spread, number of leaves and leaf area index as influenced by irrigation schedules and foliar potassium management is presented in Table 2-4.

The tallest plants were recorded with irrigation applied at 0.6 IW/CPE ratio at all the stages of crop growth. Significantly higher plant height was recorded with irrigation at 0.6 IW/CPE (19.7, 46.3 and 55.1cm) over 0.4 IW/CPE ratio (16.5, 41.4 and 47.7cm) at 25, 50 and at harvest, respectively. Irrigation scheduled at 0.6 IW/CPE ratio showed significantly higher plant spread of 16.1, 36.8 and 33.2 cm at 25 DAS, 50 DAS and at harvest, respectively over at 0.4 IW/CPE ratio. This might be due to good establishment of roots, adequate moisture supply in soil which made higher nutrient mobilization and uptake and better condition for cell division and cell enlargement, which ultimately increased the plant height and plant spread. The results are in close conformity with the findings of Yadav and Singh [18] and Patel *et al.* [19] in mungbean.

Significantly maximum number of physiologically active leaves/plant were recorded with irrigation at 0.6 IW/CPE ratio (3.82, 7.75 and 5.36 at 25, 50 DAS and at harvest, respectively) as compared to 0.4 IW/CPE ratio. Significantly maximum leaf area index was recorded under 0.6 IW/CPE ratio irrigation schedule (3.11, 4.24 and 3.77 at 25, 50 DAS and at harvest, respectively) over 0.4 IW/CPE ratio irrigation schedule at all the stages of crop growth. This might be due to more availability of essential nutrients under frequently irrigated conditions, maintenance of higher water status in plants and cooler canopy temperature which resulted into more absorption of photosynthetically active radiation and higher rate of photosynthesis that helps in formation of taller, thicker stem and root system, which ultimately increased the number of leaves/plant and LAI. The similar results were also found by Chaudhary *et al.* [16] in mungbean and Singh *et al.* [20] in french bean.

The highest dry matter production was recorded when irrigation was scheduled at 0.6 IW/CPE ratio (4.3, 8.6 and 12.4 g/plant at 25, 50 DAS and at harvest, respectively) which was significantly superior to 0.4 IW/CPE ratio. It is well known fact that sufficient supply of soil moisture helps in plant cell division and cell enlargement, resulting in better photosynthetic area, plant growth and thereby higher dry matter accumulation/plant. The similar results were also found by Idnani and Gautam [21] and Patel *et al.* [22].

Effect of foliar potassium application on growth of mungbean

The influence of foliar potassium application on plant height, plant spread, number of leaves, leaf area index and dry matter accumulation of mungbean was found to be non-significant at initial stages of crop as the potassium spray was given at the time of flowering and pod development stages.

At 50 DAS, significantly higher plant height (45.7 cm) and plant spread (36.0 cm), was recorded with the application of 1%K spray through ($KCl+KNO_3$) at flowering as compared to control but statistically similar with remaining treatments. At harvest, foliar application of 1%K through KNO_3 at flowering and pod development stage recorded significantly higher plant height (56.0 cm) and plant spread (32.7 cm) over control. This increase might be due to the well-known fact that potassium enhances the cell division and cell expansion as well as the positive influence of potassium on water and nutrient uptake, thus creating the cell turgor necessary for growth, resulting in higher plant height and plant spread. These results are in close conformity with those of Govindan and Thirumurugan [23] in mungbean, Goud *et al.* [24] in chick pea and Sanjay [25] in mungbean.

At 50 DAS, maximum number of physiologically active leaves/plant (7.63) and leaf area index (3.95) was recorded with the foliar application of 1%K by ($KCl+KNO_3$) at flowering which was significantly higher over control but remained *at par* with rest of the treatments. Maximum number of physiologically active leaves/plant (5.37) and leaf area index (3.55) at harvest was recorded with the 1%K spray through KNO_3 at flowering and pod development stage followed by 1%K spray through KCl at flowering and pod development stage though both were statistically similar but significantly higher than the control. The positive effect of potassium in increasing the number of leaves/plant and LAI might be due to its biochemical role in stimulation of photosynthesis and transfer of its products to active growing sites in addition to its role in meristematic cell division and elongation/expansion that reflects positively on leaf area index and number of branches. Al-Shaheen *et al.* [26] also opined that the water and potassium union affected the leaf area and all the plant activities, consequently an increase in plant elongation and then the leaf area. The similar findings were also made by Govindan and Thirumurugan [23] in mungbean, Balasaheb [27] in soybean and Lakshmi *et al.* [28] in urdbean.

At 50 DAS, foliar application of 1%K through ($KCl+KNO_3$) at flowering stage recorded maximum dry matter production (8.1 g/plant), being *on par* with rest of the treatments but significantly higher over control (6.9 g/plant). However, at harvest, foliar application of 1%K through KNO_3 at flowering and at pod development stage recorded higher dry matter accumulation (12.7 g/plant) which was comparable with 1%K by KCl spray at flowering and at pod development stage (12.4 g/plant) and significantly higher over rest of the treatments. The lowest dry matter production in mungbean was recorded under control plots (10.0 g/plant). The increase in dry matter accumulation/plant might be due to the fact that potassium nitrate provides potassium as well as nitrogen, both influences the water economy and crop growth, through its impact on water uptake, root growth, maintenance of turgor, transpiration and stomatal behaviour. It enhances the photosynthetic activity in plants and which ultimately led to the more biomass production/plant. Our results are in close conformity with the findings of Chandrasekhar and Bangarusamy [29] in mungbean, Vekaria *et al.* [30] in mungbean, Sanjay [25] in mungbean and Lakshmi *et al.* [28] in urdbean.

Yield

The data pertaining to yield is presented in Figure 2. Significantly higher grain yield (1100 kg/ha) and straw yield (2381 kg/ha) was observed under 0.6 IW/CPE ratio irrigation schedule over 0.4 IW/CPE ratio. However, the pace of increment in grain and straw yield of

I_1 over I_2 was to the tune of 25.2 and 9.1 %, respectively. The highest grain and straw yield at 0.6 IW/CPE ratio was mainly due to sufficient moisture supply during the entire growth period, increased irrigation frequency increased the soil moisture status which resulted into higher leaf water potential, higher photosynthesis, consequently increased the dry matter production and yield attributes, which ultimately increased grain yield and straw yield. These findings are in close conformity with those of Yadav and Singh [18] in mungbean and Patel *et al.* [19] in mungbean.

Foliar application of 1%K by KNO_3 (one at flowering and other at pod development stage) produced the significantly higher grain yield (1152 kg/ha) and straw yield (2544 kg/ha), which were statistically *on par* with 1%K by KCl spray (one at flowering and other at pod development stage) (1098 and 2478 kg/ha, respectively) than rest of the treatments. This might be due to the favourable effect of potassium on the metabolism and biological activity and its stimulating effect on photosynthetic pigments and enzyme activity, followed by efficient transfer of metabolites and subsequent accumulation of these metabolites in the grains, which results in increase in the number, size and weight of individual grain which finally increased the grain and straw yield. Our results are in close proximity with the findings of Govindan and Thirumurugan [23] in mungbean and Beg *et al.* [14] in black gram.

Nutritional aspects

The data pertaining to nitrogen content in mungbean grains and straw is presented in Table 4.

In general, the nitrogen and phosphorus content was higher in mungbean grains than straw. Potassium content was higher in mungbean straw as compared to grains. The nitrogen content (3.92 and 0.74 %), phosphorus content (0.296 and 0.210 %) and potassium content (0.53 and 1.26 %) in grains and straw, respectively were recorded significantly higher under 0.6 IW/CPE ratio irrigation schedule than 0.4 IW/CPE ratio. This increase might be due to the sufficient moisture in the soil eased the plants to absorb greater amount of water and nutrients, which in turn increased the nutrient content in grains and straw and also yielded more crop biomass. As a result, the nutrient uptake (N, P and K) was also found to be more under 0.6 IW/CPE ratio irrigation schedule. Our results are in close proximity with Arya and Sharma [31] in mungbean and Lakshmi *et al.* [28] in urdbean.

The highest nitrogen content (3.92 and 0.74 %) and phosphorous content (0.298 and 0.209 %) in grains and straw, respectively was recorded with the foliar spray of 1%K through KNO_3 at flowering and pod development stage. The minimum nitrogen and phosphorous content in grains and straw was recorded under control treatment, though the foliar application of potassium increased the nitrogen content in grains and straw of mungbean but failed to bring any significant difference among them. Significantly higher potassium content in grains and straw (0.54 and 1.24 %, respectively) was recorded under treatment with 1%K as KNO_3 sprayed at flowering and pod development stage followed by %K as KCl sprayed at flowering and pod development stage over rest of the treatments. This increase in nutrient content in mungbean was might be due to the favourable influence of potassium on plant metabolism, biochemistry, physiology and biological activity, stimulating effect on photosynthesis, water relationship, protein synthesis and requirement for K in at least 60 different enzyme systems in the plant. Higher nutrient content and grain yield resulted into higher N, P and K uptake. Our results are in close conformity with the findings of Yadav and Choudhary [32] in cowpea and Goud *et al.* [24] in chick pea. Kurhade *et al.* [33] also reported that N, P and K content in grains and straw were higher with the foliar application of 1.5% KCl at flowering and 15 days after first spray along with RDF than control.

Conclusion

From the above results, it can be concluded that irrigating the mungbean crop at 0.6 IW/CPE ratio produced significantly higher growth, yield and nutrient content in grain and straw as compared to 0.4 IW/CPE. Foliar application of 1%K as KNO_3/KCl sprayed at flowering and pod development stage recorded significantly higher as compared to other treatments. However, nutrient uptake increased with dual spray of 1%K as KNO_3/KCl sprayed at flowering and pod development stage recorded higher nutrient content as compared other treatments but did not influence significantly.

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Table 1: Initial and at harvest ('000/ha) plant population and mortality (%) of mungbean as influenced by irrigation schedules and foliar potassium management

Treatments	**Number of plants ('000/ha)**		**Mortality (%)**
	Initial	**At harvest**	
A. Irrigation schedules (IW/CPE)			
I_1-0.6	329.5	296.2	10.1

I_2-0.4	329.7	289.7	12.1
S.Em. (±)	0.1	1.0	0.2
C.D. (P=0.05)	NS	6.4	1.5
B. Foliar potassium management			
T_1-water spray	330.0	284.8	13.7
T_2-1%K by KCl at flowering	330.2	291.1	11.9
T_3-1%K by KNO_3 at flowering	329.6	292.4	11.3
T_4-1%K by ($KCl+KNO_3$) at flowering	329.7	294.2	10.7
T_5-1%K by KCl at flowering and pod development	328.8	296.8	9.8
T_6-1%K by KNO_3 at flowering and pod development	329.3	298.7	9.3
S.Em. (±)	0.3	7.5	1.2
C.D. (P=0.05)	NS	NS	NS

Table 2: Effect of irrigation schedules and foliar potassium management on plant height and plant spread of mungbean

Treatment	Plant height (cm)			Plant spread (cm)		
	25 DAS	50 DAS	At harvest	25 DAS	50 DAS	At harvest
A. Irrigation schedules (IW/CPE)						
I_1-0.6	19.7	46.3	55.1	16.1	36.8	33.2
I_2-0.4	16.5	41.4	47.7	13.9	30.8	27.4
S.Em. (±)	0.4	0.6	0.7	0.3	0.8	0.7
C.D. (P=0.05)	2.4	3.8	4.7	1.9	5.3	4.5

T_1-water spray	18.3	38.8	44.4	14.9	29.1	26.1
T_2-1%K by KCl at flowering	18.6	44.1	50.4	14.6	33.4	29.4
T_3-1%K by KNO_3 at flowering	17.5	45.3	51.6	15.8	34.7	30.2
T_4-1%K by ($KCl+KNO_3$) at flowering	18.7	45.7	52.0	15.2	36.0	31.4
T_5-1%K by KCl at flowering and pod development	17.7	44.4	53.9	15.6	34.1	32.1
T_6-1%K by KNO_3 at flowering and pod development	18.2	45.1	56.0	14.2	35.4	32.7
S.Em. (±)	0.8	1.1	1.3	0.5	0.9	0.9
C.D. (P=0.05)	NS	3.2	4.0	NS	2.7	2.6

Table 3: Number of physiologically active trifoliate leaves/plant and LAI in mungbean as influenced by irrigation schedules and foliar potassium management

Treatment	**Number of physiologically active trifoliate leaves/plant**			**LAI**		
	25 DAS	**50 DAS**	**At harvest**	**25 DAS**	**50 DAS**	**At harvest**
A. Irrigation schedules (IW/CPE)						
I_1-0.6	3.82	7.75	5.36	3.11	4.24	3.77
I_2-0.4	2.88	6.47	4.40	2.16	3.32	2.91

S.Em. (±)	0.08	0.20	0.15	0.07	0.10	0.08
C.D. (P=0.05)	0.53	1.32	0.95	0.47	0.63	0.49
T_1-water spray	3.45	5.93	4.05	2.64	3.50	3.05
T_2-1%K by KCl at flowering	3.33	6.95	4.77	2.63	3.73	3.28
T_3-1%K by KNO_3 at flowering	3.50	7.53	4.87	2.59	3.83	3.30
T_4-1%K by ($KCl+KNO_3$) at flowering	3.57	7.63	4.95	2.52	3.95	3.35
T_5-1%K by KCl at flowering and pod development	3.17	7.17	5.27	2.61	3.76	3.52
T_6-1%K by KNO_3 at flowering and pod development	3.07	7.43	5.37	2.83	3.91	3.55
S.Em. (±)	0.13	0.21	0.16	0.09	0.08	0.06
C.D. (P=0.05)	NS	0.63	0.47	NS	0.23	0.19

Table 4: Dry matter accumulation (g/plant) of mungbean as influenced by irrigation schedules and foliar potassium management

Treatment	**Dry matter accumulation (g/plant)**		
	25 DAS	**50 DAS**	**At harvest**
I_1-0.6	4.3	8.6	12.4
I_2-0.4	3.2	6.9	10.6

S.Em. (±)	0.1	0.2	0.3
C.D. (P=0.05)	0.6	1.2	1.7
T_1-water spray	3.6	6.9	10.0
T_2-1%K by KCl at flowering	3.9	7.9	11.1
T_3-1%K by KNO_3 at flowering	3.8	8.0	11.3
T_4-1%K by ($KCl+KNO_3$) at flowering	3.7	8.1	11.5
T_5-1%K by KCl at flowering and pod development	3.9	7.8	12.4
T_6-1%K by KNO_3 at flowering and pod development	3.5	8.0	12.7
S.Em. (±)	0.1	0.2	0.4
C.D. (P=0.05)	NS	0.7	1.0

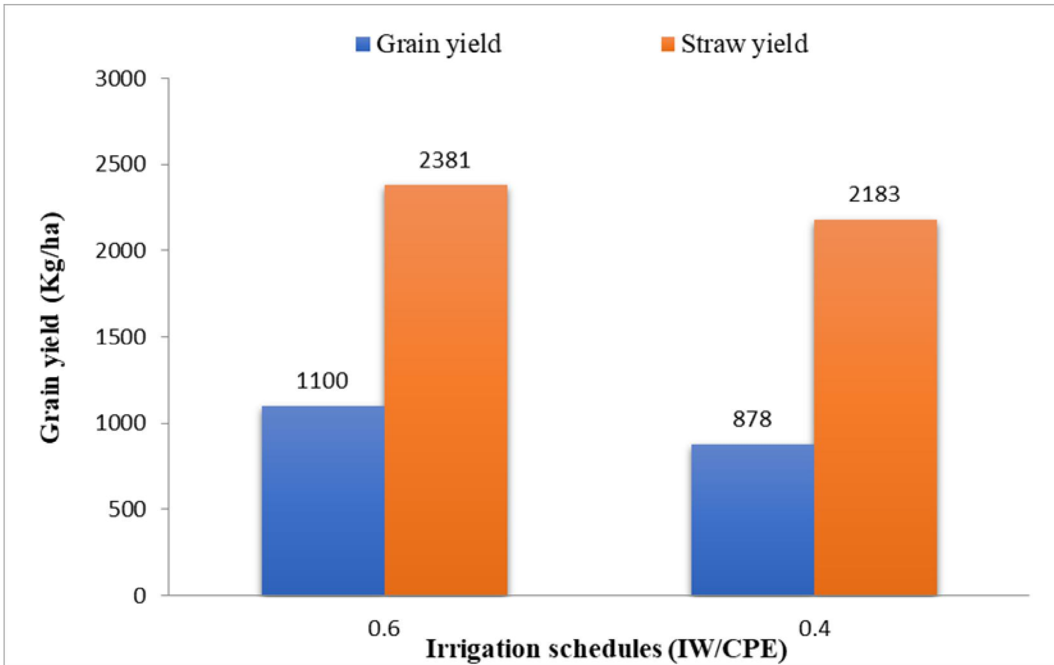

Fig. 2(a): Effect of irrigation schedules on grain and straw yield (kg/ha) of mungbean

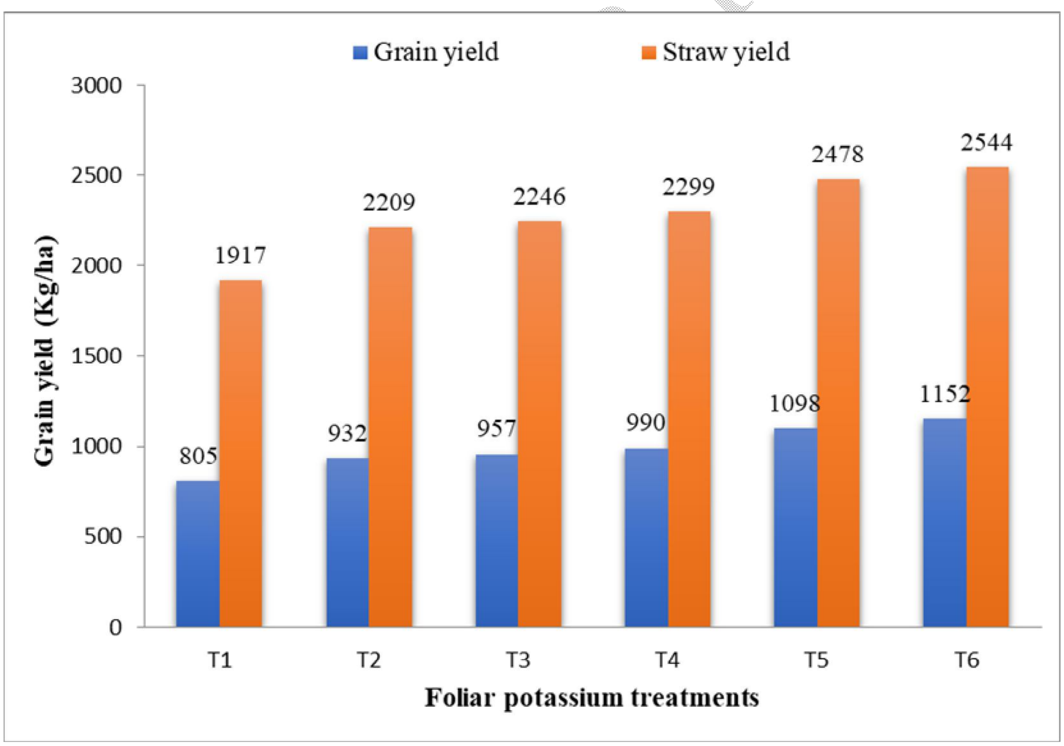

Fig. 2(b): Effect of foliar potassium management on grain and straw yield (kg/ha) of mungbean

Table 5: Effect of irrigation schedules and foliar potassium management on nitrogen, phosphorus and potassium uptake (kg/ha) of mungbean

Treatment	N content (%)		P content (%)		K content (%)	
	Grains	**Straw**	**Grains**	**Straw**	**Grains**	**Straw**
A. Irrigation schedules (IW/CPE)						
I_1-0.6	3.92	0.74	0.296	0.210	0.53	1.26
I_2-0.4	3.69	0.56	0.255	0.185	0.48	1.16
S.Em. (±)	0.03	0.02	0.005	0.003	0.01	0.01
C.D. (P=0.05)	0.21	0.14	0.031	0.021	0.05	0.06
B. Foliar potassium management						
T_1-water spray	3.68	0.52	0.253	0.184	0.47	1.15
T_2-1%K by KCl at flowering	3.76	0.63	0.266	0.193	0.49	1.20
T_3-1%K by KNO_3 at flowering	3.79	0.63	0.270	0.196	0.50	1.21
T_4-1%K by ($KCl+KNO_3$) at flowering	3.81	0.66	0.274	0.198	0.51	1.22
T_5-1%K by KCl at flowering and pod development	3.87	0.72	0.290	0.205	0.53	1.24
T_6-1%K by KNO_3 at flowering and pod development	3.92	0.74	0.298	0.209	0.54	1.24
S.Em. (±)	0.05	0.05	0.010	0.006	0.01	0.02
C.D. (P=0.05)	NS	NS	NS	NS	0.04	0.05