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Influence of Different Potassium (K) Application On Seed Glucosinolate Content Of Brassica Under Stress Condition In The Field

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ABSTRACT

Field experiments were laid out in randomized complete block design (RCBD) with split plot arrangements at Malakandher Research Farm Khyber Pakhtunkhwa Agricultural University Peshawar Pakistan to study the effect of different levels of irrigation and potassium on seed protein content of Brassica. Four varieties Wester, Rainbow, Oscar and Legend were selected on the basis of their good response to potassium application in water stress conditions. maximum GSL content (49.2 µmol g^{-1}) was observed in treatments of 100% irrigation while minimum GSL content (16.4 µmol g^{-1}) was produced by plants where 60% irrigation was applied. potassium showed maximum GSL content (34.7 µmol g^{-1}) with 60 kg K ha^{-1} and minimum GSL content (31.0 µmol g^{-1}) was observed in treatments with 120 K kg ha^{-1}. The data shown in appendix A29 suggested that maximum GSL content (40.7 µmol g^{-1}) was produced by variety Wester (V1) when applied with 60 kg K ha^{-1} and minimum GSL content (25.7 µmol g^{-1}) was given by variety Legend (V4) when treated with 120 kg K ha^{-}. case of interaction between I x K, maximum GSL content (50.7 µmol g^{-1}) was noted in plants treated with 60 kg K ha^{-1} and 100% irrigation level while minimum GSL content (14.1 µmol g^{-1}) with 120 kg K ha^{-1} and 60% irrigation level. Further, the data given in appendix A29 indicated that maximum GSL content (56.5 µmol g^{-1}) was produced by variety Wester (V1) when treated with 100% irrigation level and 60 kg K ha^{-1} while minimum GSL content (8.9 µmol g^{-1}) was also given by variety Wester (V1) at 120 kg K ha^{-1} and 60% irrigation level.

Keywords. Glucosinolate, Potassium, Irrigation, Variety, Treatment

INTRIDUCTION

Ever increasing population, expanding urbanization, marginal oilseed cultivation, frequently prolonged and intermittent drought and unavailability of high yielding drought tolerant varieties are highly influential concerns of this upsurge. Water shortage is not only characteristic of arid and semi-arid climate, water availability is becoming increasingly limited for irrigated agriculture due to increased cropping intensity and diminishing resources of water. Plants can have mechanisms to escape, avoid and/or resist to drought. They can also escape drought by adjusting their phenological development according to the water availability in their habitat. Drought escape is the ability of the plant to mature; before drought becomes a serious limiting factor (Arraudeau, 1989). Water stress increases root growth and decrease shoot growth generally (Richards, 1978 and Paez et al., 1995), whereas decrease in water loss is achieved through transpiration adjustment. Although non-traditional oilseed crops such as sunflower, safflower, soybean and palm oil have been introduced, yet, the efforts apparently failed to fulfill the need of the Pakistan. Plants in water stress and K^+ levels revealed important variations in contrast to control treatments. In this background, plants with advanced levels of K^+ illustrated high resistance to drought strain circumstances and higher yield and dry matter portion to harvest index. Results recommended that drought stress directs to production of oxygen radicals, where results in augmented lipid per oxidation biomarker and oxidative stress in the sow (Soleimanzadeh et al.2010). The influence of water stress on water use efficiency, seed yield, seed oil content, protein level, harvest index, biological yield and seed yield was highly significant, while, the highest values of water use efficiency and seed yield were ebonite and best. In normal irrigation the highest water use efficiency were in Ebonite, Elite and SLM046. Oil content were highly significant, the maximum seed oil content were obtained in Ebonite (Sinaki et al. 2007). yield and yield components were mostly influenced with water deficit happening of flowers to seed deposit. a clear decrease in oil content when water deficiency happened from antheses to physiological maturity. There was an opposite relation between oil and protein contents. They noticed the majority obvious result on the Glucosinolate content, where enhances up to 60 percent were recorded. In addition, they recommended that results might make clear effects on grain quality of field grown oilseed rape (Champoliver and Marrien,1996)

MATERIAL AND METHODS

The experimental site Khyber Pakhtunkhwa Agricultural University Peshawar is situated about 1700 km in the north of Indian Ocean at 34^{o}N latitude, 72^{o}E longitude and an altitude of 290 meters above sea level. Field experiments at Malakandher Research Farm Khyber Pakhtunkhwa Agricultural University Peshawar using Randomized Complete Block design with split plot arrangement. The treatments studied during the study at irrigation level of I_1(100%), I_2 (80 %) and I_3(60 %) replacement of ET_a. Potassium (K) Levels were K_1 (60 kg ha^{-1}), K_2 (90 kg ha^{-1}) and K_3 (120 kg ha^{-1}) where as brassica varieties were Wester (V_1), Rainbow(V_2), Oscar (V_3) and Legend (V_4). The time of irrigation required to obtain the desired depth of irrigation for each treatment was calculated by using the equation according to James (1993).Biological yield was calculated by taking the weight of all plants in each treatment and then seed yield was subtracted from it and converted into Kgha^{-1}. Grain yield was calculated by threshing all pods of the plants in each treatment and then converted into grain yield Kgha^{-1}. The simple procedure of finding the index of harvest was used by division of total grain yield per hectare with total biological yield per hectare and multiplying with hundred. Different qualitative and quantitative parameters Glucosinolate content (%) was recorded from the produce of each treatment using Near Infra Red (NIR) Spectroscopy at oilseed laboratory, Nuclear Institute for Food and Agriculture (NIFA), Peshawar. Data was analyzed according to randomized complete block (RCB) design with split plot arrangements using ANOVA (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of Irrigation on Glucosinolate (GSL) Content

Figure 3.1 reveals the data on GSL content of brassica varieties as affected by different levels of irrigation application. The statistical analysis of the data indicated that irrigation (I) application significantly ($P<0.05$) effected GSL content of brassica. It was noted from the data that maximum GSL content (49.2 µmol g^{-1}) was observed in treatments of 100% irrigation while minimum GSL content (16.4 µmol g^{-1}) was produced by plants where 60% irrigation was applied. Maximum GSL content (50.4 µmol g^{-1}) was produced by variety Wester (V1) with 100% irrigation level while minimum GSL content (15.2 µmol g^{-1}) was resulted by variety Oscar (V3) when treated with 60% irrigation level. Seed glucosinolates decreased with decreasing irrigation water availability Similar results of a decrease in glucosinolates content in response to drought imposition have been reported for *Arabidopsis thaliana* (Sun et al., 2010). Thus the findings of this experiment of a decrease in glucosinolates content are in agreement with previous literature. However, Jensen et al. (1996) reported the glucosinolate content increased linearly with the number of stress days

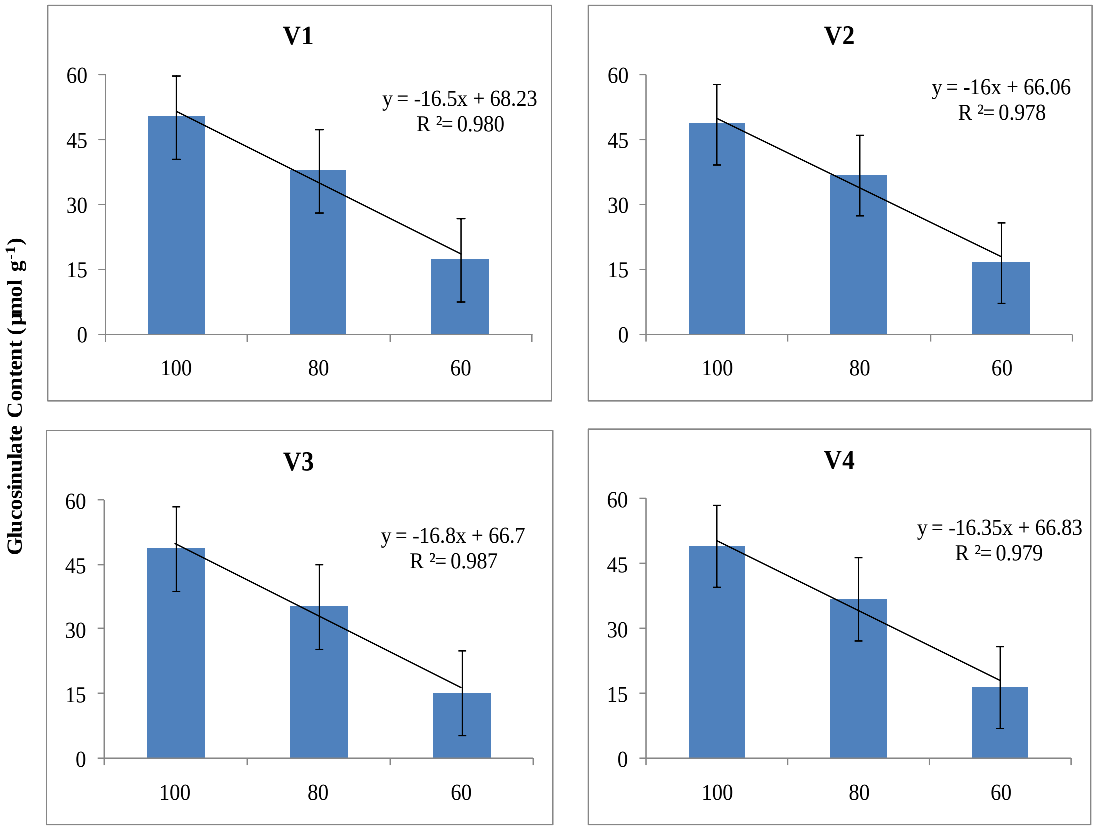

Figure 3.1: Effect of different levels of irrigation on Glucosinolate content of brassica varieties.

Effect of Potassium on Glucosinolate (GSL) Content

The data about GSL content of brassica varieties as affected by different levels of potassium application is shown in Figure 3.2. The statistical analysis of the data revealed that potassium application had a high significant ($P<0.05$) effect on GSL content of brassica. Data further indicated that potassium showed maximum GSL content (34.7 µmol g^{-1}) with 60 kg K ha^{-1} and minimum GSL content (31.0 µmol g^{-1}) was observed in treatments with 120 K kg ha^{-1}. Maximum GSL content (40.7 µmol g^{-1}) was produced by variety Wester (V1) when applied with 60 kg K ha^{-1} and minimum GSL content (25.7 µmol g^{-1}) was given by variety Legend (V4) when treated with 120 kg K ha^{-1}. Glucosinolates are a group of naturally occurring thioglucosides, present in Brassica plants (e.g., canola and cabbage). Glucosinolate degradation products display diverse biological activities, including defense against insects and herbivores, N/S nutrition and growth regulation. Khan et al. (2010) reported that brassica plants grown for 2 weeks under drought stress were significantly smaller and showed decreased levels of total glucosinolates when compared with well-watered plants.

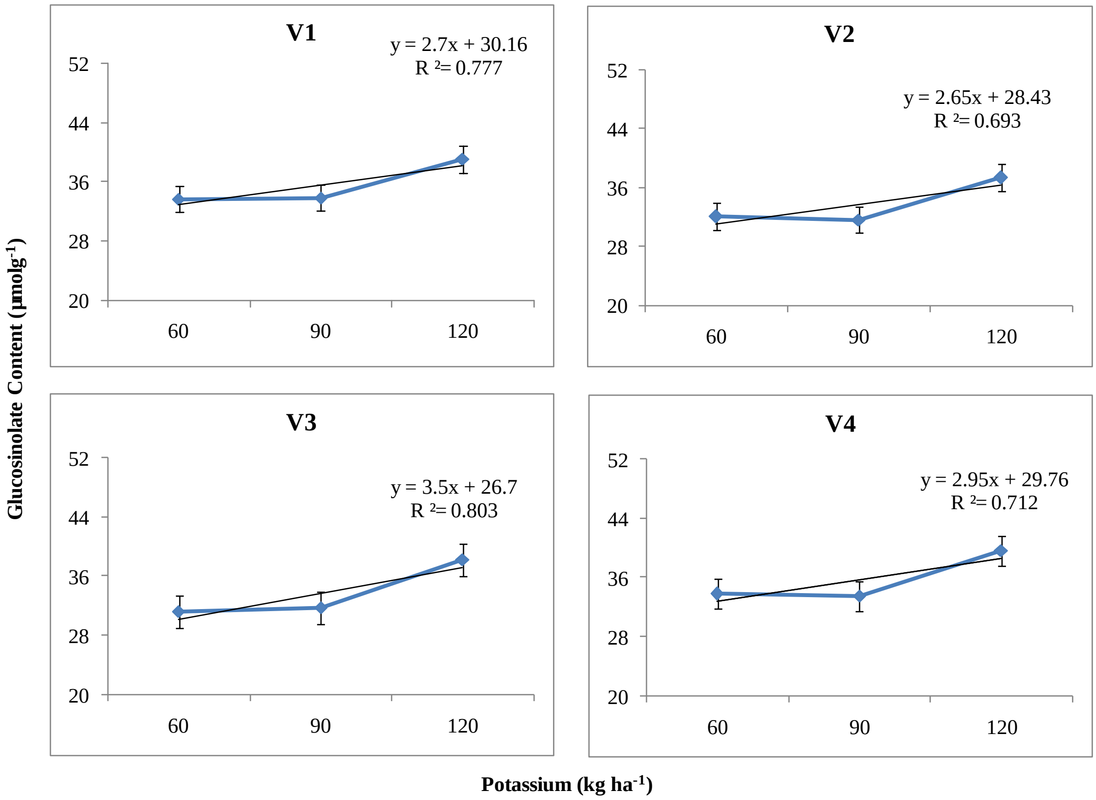

Figure 3.2: Effect of different levels of potassium (K) on Glucosinolate content of brassica varieties.

V1 = Wester V2 = Rainbow V3 = Oscar V4 = Legend

Comparison of Potassium and Irrigation with Glucosinolate (GSL) Content

Figure 3.3 presents data regarding to GSL content of brassica varieties as affected by different levels of I x K interaction. The analysis of the data indicated that I x K interaction had also a strong significant ($P<0.05$) effect on GSL content of brassica. In case of interaction between I x K, maximum GSL content (50.7 µmol g^{-1}) was noted in plants treated with 60 kg K ha^{-1} and 100% irrigation level while minimum GSL content (14.1 µmol g^{-1}) with 120 kg K ha^{-1} and 60% irrigation level. Maximum GSL content (56.5 µmol g^{-1}) was produced by variety Wester (V1) when treated with 100% irrigation level and 60 kg K ha^{-1} while minimum GSL content (8.9 µmol g^{-1}) was also given by variety Wester (V1) at 120 kg K ha^{-1} and 60% irrigation level. The brassica genotypes showed variation in seed glucosinolate content to K^+ application. There was an increase or decrease in seed glucosinolate content with increasing K^+ application in two varieties each). The interaction of K^+ and irrigation water application had also resulted in a decrease in seed glucosinolate content, but it can be inferred from the slope of regression line that this decrease with increasing K^+ quantity applied was more significant when 60% of the ETa was replenished with irrigation.

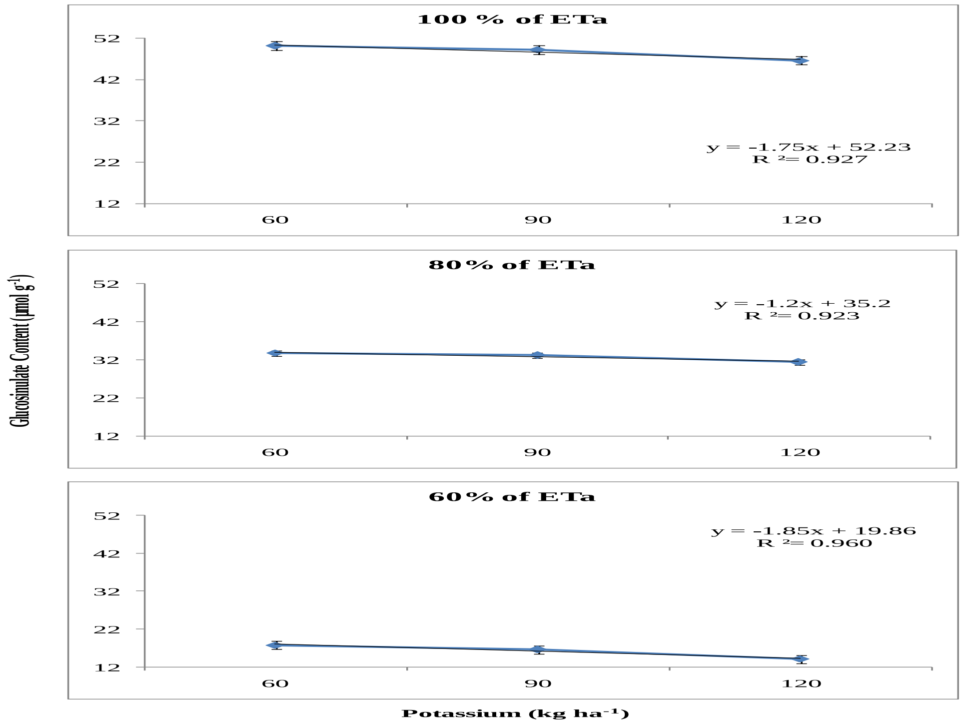

Figure 3.3: Effect of different levels of IxK on Glucosinolate content of brassica varieties

CONCLUSIONS

Maximum GSL content (34.7 µmol g^{-1}) with 60 kg K ha^{-1} and minimum GSL content (31.0 µmol g^{-1}) was observed in treatments with 120 K kg ha^{-1}. maximum GSL content (40.7 µmol g^{-1}) was produced by variety Wester (V1) when applied with 60 kg K ha^{-1} and minimum GSL content (25.7 µmol g^{-1}) was given by variety Legend (V4) when treated with 120 kg K ha^{-}. case of interaction between I x K, maximum GSL content (50.7 µmol g^{-1}) was noted in plants treated with 60 kg K ha^{-1} and 100% irrigation level while minimum GSL content (14.1 µmol g^{-1}) with 120 kg K ha^{-1} and 60% irrigation level. maximum GSL content (56.5 µmol g^{-1}) was produced by variety Wester (V1) when treated with 100% irrigation level and 60 kg K ha^{-1} while minimum GSL content (8.9 µmol g^{-1}) was also given by variety Wester (V1) at 120 kg K ha^{-1} and 60% irrigation level.

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