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Impact of Different Potassium (K) Application on Seed Protein Content of Brassica under Different Levels of Irrigation in Field Condition

Gul Daraz Khan[1], Murad Ali[1], Farid Akbar[2] and Muhammad Hameed[1]
1, Department of Water Management, The University of Agriculture, Peshawar, Pakistan
2, Faculty of Water Resources Management, Lasbela University of Agriculture, Water and Marine Sciences Uthal, District Lasbela
Corresponding Email. farid.baloch@hotmail.com

Abstract
Pakistan is confronting a chronic scarcity of domestic edible oil requirements. One of the major issues with brassica oil seed production is the water requirement of the brassica crop. 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. The data revealed that maximum seed protein content (21.98%) was observed in those treatments where 100% irrigation level was applied and minimum seed protein content (19.37%) was produced by plants where 60% irrigation level was applied. Maximum seed protein content (21%) was in plants treated with 120 kg K ha^{-1} and minimum seed protein content (20.14%) with 60 kg K ha^{-1}. The interaction between I x K showed maximum seed protein content (22.43%) in those plants treated with 100% irrigation level and 120 kg K ha^{-1} and minimum seed protein content (19.14%) was observed with 60 kg K ha^{-1} and 60% irrigation level. Maximum seed protein content (22.77%) was produced by variety Wester (V1) at 100% irrigation level and 120 kg K ha^{-1} while minimum seed protein content (18.80%) was given by variety Oscar (V3) when treated with 60 kg K ha^{-1} and 60% irrigation level.
Keywords: Brassica, Oil Seed, Seed Protein, Variety, Irrigation, Potassium.

INTRODUCTION

The climate of Pakistan is characterized as arid to semi-arid showing deficiency of water for potential crop production. 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. Brassicas that include rapeseed (*B. napus* and *B. campestris*) and mustards (*B. juncea* and *B. carinata*) are the second largest contributor after cottonseed to the indigenous edible oil production in Pakistan accounting for about 30% of the total domestic production (Khan et al., 1987). Brassica have been cultivated in Indo-Pak subcontinent since ancient times as traditional oilseed crops and still are grown all over the country. Sunflower due to low water use efficiency compared to rapeseed and mustards is not well adapted to semi-arid conditions (Miller et al., 1998). Shalhevet et al. (1985) reported the development of longer roots in stress than control in different plants. 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. Potassium (K) is an essential nutrient required for plant growth and reproduction. It is very important to many plant processes. Its role involves accepting the basic biochemical physiological systems of plants. Potassium does not develop into a part of chemical structure of plants. It plays numerous significant roles in development. With rising stress severely grain yield reduced, except K^+ application awarded huge increase on rapeseed yield. It is clear that K^+ Levels could improve negative effects of water stress on seed yield and physiological indicators and as a result improved them (Fanaei et al. 2009). Proteins are not totally necessary for desiccated tolerant. Even though the (heat shock protein) HSP investigated was also not present in grains from well-irrigated crop as desiccated tolerant augmented, the syntheses was encouraged in post harvest dying. But, the quantities of HSP produced in drying then decreased later during development, However grains stayed desiccated acceptant. Throughout the time when grains were desiccated acceptant one among three proteins was there before dying and produced in large quantities on drying. In broad spectrum, the protein continued to be accumulated in grains after maturity at the same moment that potential durability was rising (Bettey et al. 1998).

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 Protein 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 DISSCUSSION

Effect of Irrigation Levels on Seed Protein Content

Figure 3.1 reveals the data pertaining to seed protein content of brassica varieties as affected by different levels of irrigation application. The statistical analysis of the data indicated that irrigation (I) application had a high significant ($P<0.05$) effect on seed protein content of brassica. The data revealed that maximum seed protein content (21.98%) was observed in those treatments where 100% irrigation level was applied and minimum seed protein content (19.37%) was produced by plants where 60% irrigation level was applied. Maximum seed protein content (22.28%) was produced by variety Wester (V1) when 100% irrigation level was applied while minimum seed protein content (19.23%) was retained by variety Oscar (V3) when treated with 60% irrigation level. Similar results of decrease in seed oil content under water shortage are previously reported by Hamidreza and Mohsin (2012). Since water deficit stress restricts CO_2 assimilation, the formation of a superoxide radical by the transfer of electrons from PSI to molecular oxygen (Mehler reaction) is enhanced (Badger, 1985). A Superoxide radical is rapidly scavenged by superoxide dismutases, thus producing H_2O_2.

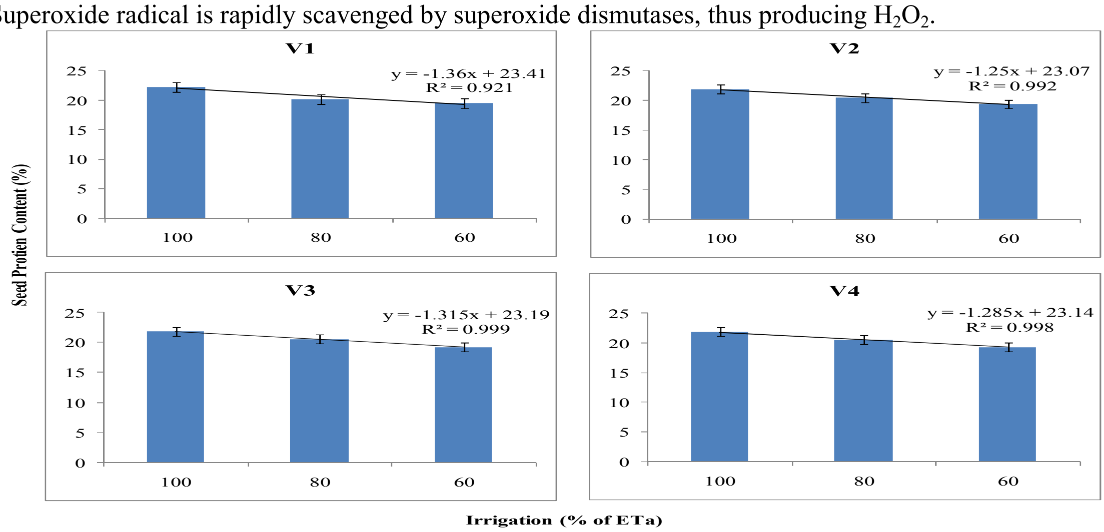

Figure 3.1: Effect of different levels of irrigation on seed protein content of brassica varieties

Effect of Potassium on Seed Protein Content

The data on seed protein 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 significant ($P<0.05$) effect on seed protein content of brassica. In case of potassium, maximum seed protein content (21%) was in plants treated with 120 kg K ha^{-1} and minimum seed protein content (20.14%) with 60 kg K ha^{-1}. Maximum seed protein content (21.05%) was produced by variety Wester (V1) when treated with 120 kg K ha^{-1} and minimum seed protein content (20.033%) was given by variety Legend (V4) when treated with 60 kg K ha^{-1}. Furthermore, K^+ application with different irrigation regime had significantly increased protein and oil content but decreased seed moisture content (Chapter IV; Figure 4.26c, 27c and 28c). K^+ is known to play a vital role in protein synthesis and stability (Marschner, 1995). The observed increase in the protein content with increasing K^+ application at low moisture conditions in this experiment would result in increasing capacity of plants to scavenge the ROS produced. This might be responsible for an improvement in physiological and biochemical characteristics of the seeds

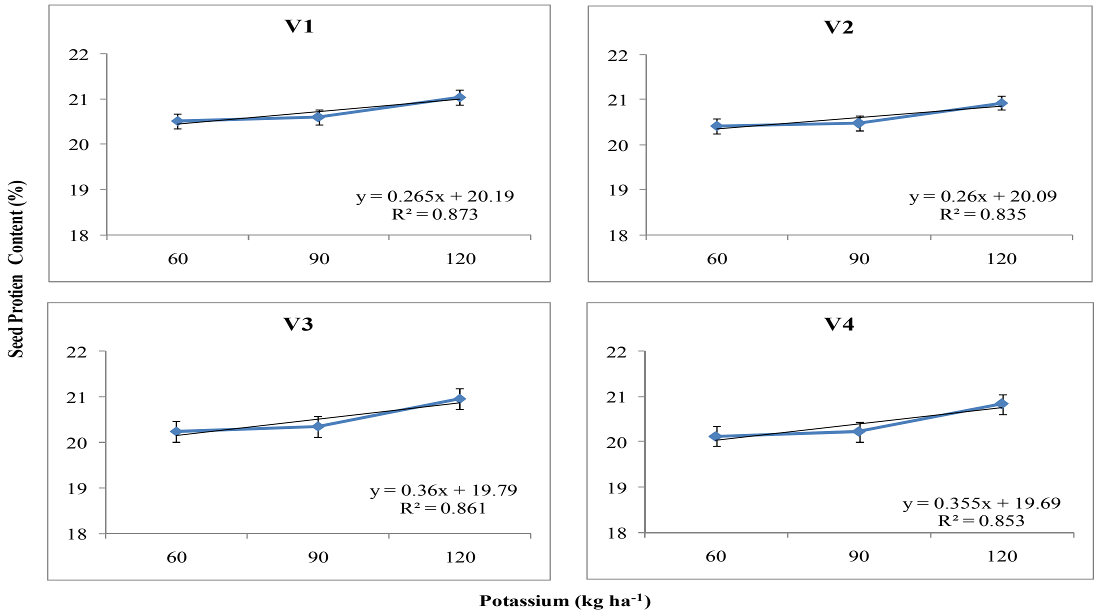

Figure 3.2: Effect of different levels of potassium (K) on seed protein content of brassica varieties.

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

Comparison of Protein content with Irrigation and Potassium

Figure 3.3 shows data concerning to seed protein 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 a non significant ($P<0.05$) effect on seed protein content of brassica. The interaction between I x K showed maximum seed protein content (22.43%) in those plants treated with 100% irrigation level and 120 kg K ha^{-1} and minimum seed protein content (19.14%) was observed with 60 kg K ha^{-1} and 60% irrigation level. Maximum seed protein content (22.77%) was produced by variety Wester (V1) at 100% irrigation level and 120 kg K ha^{-1} while minimum seed protein content (18.80%) was given by variety Oscar (V3) when treated with 60 kg K ha^{-1} and 60% irrigation level. However, unlike this experiment they reported that the potassium fertilizer and interaction effect of I x K was not significant on seed oil percentage. An increase in seed oil content with potassium application under both irrigated and drought stress conditions have been previously reported (Kene, 1990). Similarly, Deshmukh et al. (1993) reported that K^+ application had increased the protein and oil content of groundnut.

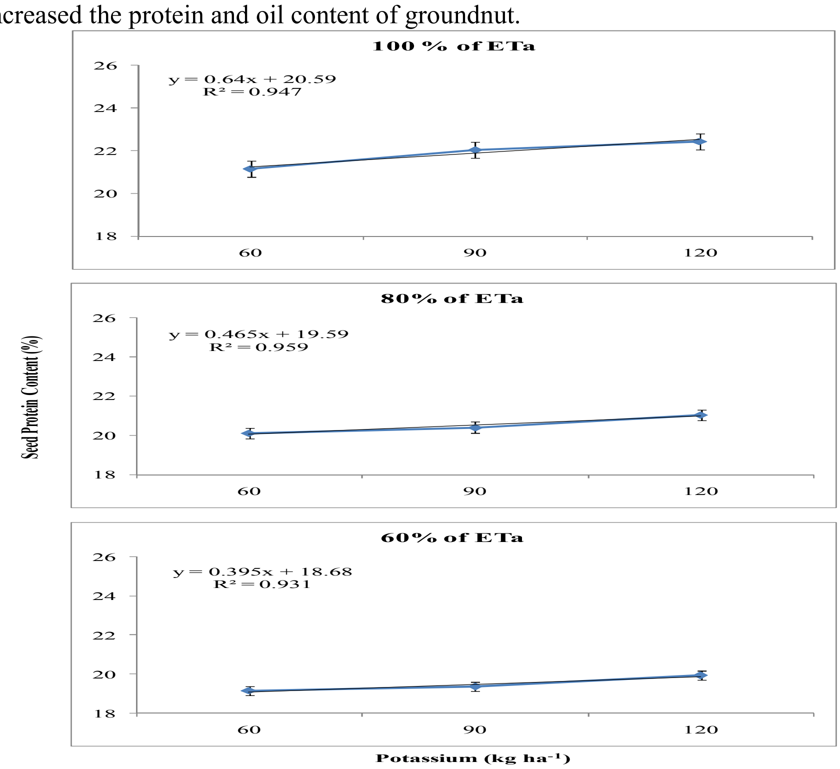

Figure 3.3: Effect of different levels of IxK on seed protein content of brassica varieties

CONCLUSIONS

Maximum seed protein content (21.98%) was observed in those treatments where 100% irrigation level was applied and minimum seed protein content (19.37%) was produced by plants where 60% irrigation level was applied. It can be seen from the data presented in appendix A26 that maximum seed protein content (22.28%) was produced by variety Wester (V1) when 100% irrigation level was applied while minimum seed protein content (19.23%) was retained by variety Oscar (V3) when treated with 60% irrigation level. Maximum seed protein content (21%) was in plants treated with 120 kg K ha^{-1} and minimum seed protein content (20.14%) with 60 kg K ha^{-1}. The interaction between I x K showed maximum seed protein content (22.43%) in those plants treated with 100% irrigation level and 120 kg K ha^{-1} and minimum seed protein content (19.14%) was observed with 60 kg K ha^{-1} and 60% irrigation level. Maximum seed protein content (22.77%) was produced by variety Wester (V1) at 100% irrigation level and 120 kg K ha^{-1} while minimum seed protein content (18.80%) was given by variety Oscar (V3) when treated with 60 kg K ha^{-1} and 60% irrigation level.

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