INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 15, No. 3, p. 489-495, 2019

RESEARCH PAPER OPEN ACCESS

Impact of soil composition on growth and proximate analysis of ecotypes of *Brassica oleracea* L.

Rashid Abbas Khan*[1], Tauqeer Ahmed Qadri[2], Amjid Khan[2]

[1]*Department of Botany, University of Education, Lahore, Pakistan*

[2]*Department of Biosciences, University of Wah, Wah Cantt, Pakistan*

Key words: Ecotypes, *Brassica oleracea*, Crude fiber, Crude protein

http://dx.doi.org/10.12692/ijb/15.3.489-495 Article published on September 30, 2019

Abstract

This study examined the growth parameters and proximate composition and soil composition of different ecotypes of *Brassica oleracea* L. The sample of Mianwali showed improved growth but sample collected from Kala-Bagh showed destructive growth and proximate composition as compared to other ecotypes. The maximum plant height (40.33cm) and leaf size (14.2cm), Weight of Curd (456g), Diameter of Curd (10.1cm), Fresh weight of root (21cm) and length of roots (24cm) were recorded in Sample collected from Mianwali. The comparison of proximate composition of ecotypes determined that maximum total ash values (19.67%) were recorded in the sample of Mianwali, highest moisture percentage (95.34%) were recorded in sample of Isa-khail, highest values (21.28%) of crude fiber and (29.043%) of crude protein were recorded in the sample of Mianwali and highest values (1.92%) of fats were recorded in the sample of Sultan-khail. The findings suggest that *Brassica oleracea* L. is a widely affected by environment and is chief source of crude fiber, fats and crude protein. It has high potential as a vegetable in the treatment of diseases so it is known as hospital so far.

* **Corresponding Author:** Rashid Abbas Khan ✉ rashidabbaskhan98@gmail.com

Introduction

Pakistan is an agricultural country and many vegetables are grown during winter and summer season but *Brassica oleracea* L. is important vegetable for farmers. District Mianwali is located in the South-Western side of the province Punjab. Normal greatest temperature per annum is 47°C and 19°C is the least. Mean yearly rain fall of the District Mianwali is 3.3mm.Three kinds of soils are found i.e., sandy, mud and loamy. Pakistan in the production of *Brassica oleracea* ranked 19th in the world. (Baloch, 2015). An average yield of cauliflower in Pakistan is 17t/ha and largest producing country china has 2.7t/ha. (FAO, 2017). It is usually grown in Pakistan during winter season and soil should be very fertile, proper nutrient and moisture holding for better growth of cauliflower. It grows on PH range between 6 to 6.5. it is highly medicinal and prevents cancer from reoccurring. (Qamar ***et al***., 2017). *Brassica oleracea* L. **I**s agreen leafy vegetable and belong to family Brassicaceae. (Emebu, 2011). Cauliflower has low calories, high vitamin C and good source of fiber and folic acid, Vitamin B6 & B5 and minerals like phosphorous and potassium. (FAO, 1988). Cauliflower is an important source of minerals and vitamins for humans. Only the head called white curd is eaten. The curd formation is strongly influenced by weather parameters. It was considered as temperate crop but now a day with the development of new varieties which are adapted to hot and humid climates (Karthika *et al*., 2016). Brassica species has anticancer properties, due to glucosinolates. The leaves are curly and ornamentals but tough to eat. In Nigeria it is known as hospital so far (Emebu, 2011). Leafy vegetables have a key role in tradition and African households' medicines (Mariga *et al.,* 2012).

Proximate analysis of food refers to the total contents of foods. Proximate composition of the *Brassica oleracea* L. involves the moisture, total ash, crude protein, crude fiber and fats. Proximate analysis is usually investigating the nutritional values of the foods. It is more accurate method for the quality control by official methods. The recent study was conducted to investigate the proximate composition of locally commonly grown vegetable (*Brassica oleracea* L.) different ecotypes that were collected from different localities with different soils and environments.

Materials and method

Sample preparation

The *Brassica oleracea* L. Plants were collected by random selection from the fields of Mianwali, Isa-khail, Kala-Bagh, Sultan-khail and Makerwal. The curd, leaves and roots ware separated from the stalk and washed with the clean water to remove the dust.

Water holding capacity

Soil water holding capacity was determined by following method of Hesse (1971). Firstly, the cane with perforated bottom was taken in which filter paper was fitted at the bottom. Soil was put into the cane and water was mixed into the cane slightly. Then the soil paste was prepared by spatula by thorough mixing and then soil sample was weighted by balance. After weighting the sample, it was put into the oven at 105°C for 24 hours. After 24 hours sample was taken from oven and was reweighted. Readings and difference were noted and WHC was calculated by using following formula;

WHC= Weight of saturated soil- Weight of oven dried soil/weight of oven dried soil × 100.

pH

The pH was determined by following procedure of Mc Keague (1978). Soil (50g) air dried and 50ml of distilled water was added into 100ml glass beaker and gentle mix them with glass rod and place for 30 minutes and suspension was done after 10 minutes and then combined electrodes were dipped in suspension 3cm deep and after 30 seconds, the readings were noted. After noting the readings, the electrodes were removed from suspension and were cleaned by removing the excess water with a tissue paper.

Electrical Conductivity

The methodology for measuring the EC of soil is given below as described by Richards (1954). The soil-water suspension was prepared in ratio 1:1. With the help of Whatman filter paper no. 42, the suspension was filtered and then shifted in the Buchner funnel.

Then vacuum filtration pump was started and suction was opened. Soil was filtered on the funnel until the soil starts cracking. Then filtrate was transferred into a 50ml bottle and the conductivity cell was immersed in the filtrate and readings were noted. After noting the readings, conductivity cell was removed and was cleaned carefully by removing the excess water with tissue paper.

Organic Matter

Organic matter in the soil was measured by following method as given by FAO (1974).

Proximate Analysis

Moisture, total ash, crude protein, crude fiber and fats of the flowers (white curd) of *Brassica oleracea* L. were determined by official methods of AOAC 1990 & AOAC 2000.

Statistical Analysis

The results generated from each experiment were subjected to analyze under complete randomized design. ANOVA and standard errors were determined by using the CoStat statistical program (CoHort software 1988).

Results and discussion

Growth parameters

The following parameters were studied.

Plant Height (cm)

The table1 showed that plant height of the samples collected from Mianwali were significantly maximum (P<0.05) than followed by sample of Isa-Khail. While minimum plant height was recorded in the samples of Kala-Bagh. The maximum height of (30.3cm) was also reported in *Brassica oleracea* by (Reza *et al*., 2017). The sample collected from Mianwali showed significantly (P<0.05) maximum plant height as compared to other ecotypes because the soil is fertile and no contamination of heavy metals while the area of Kala-Bagh is mostly affected by salinity and due to the salinity effects, the *Brassica oleracea* L. height were minimum. The electrical conductivity also favors the improvement of plant height in Mianwali sample, while higher electrical conductivity and lower ranges effect adversely on plant height as reported by (Ding *et al*., 2018).

Leaf size (cm)

Table1 showed that leaf size in the sample of Mianwali is significantly (P<0.05) maximum as compared to other ecotypes and Sample of kala-Bagh showed minimum leaf size due to salinity. The effect of salinity decreases leaf size was reported by Dolatabadian *et al.,* 2011; Kumar Biswas *et al.,* 2016. The leaf size increased in the sample of Mianwali, Isa-khail and Sultan-hail but decreased in the Kala-Bagh sample due to difference in soil texture and electrical conductivity. As high or low ranges of electrical conductivity decreased the leaf size. (Ding *et al*., 2018).

CurdWeight (g) & Curd Diameter (cm)

The findings of recent study as mentioned in table1 describes that significantly (P<0.05) maximum values of weight of white curd and diameter of white curd were recorded in *Brassica oleracea* L. Sample collected from Mianwali, while lowest values were recorded in samples of Kala-Bagh. The maximum curd size and weight under favorable condition were also reported by (Shapla *et al*., 2014; Sari *et al*., 2000) and variation in curd size were reported by (Sermenli *et al*., 2011).

Fresh weight of Root/plant, Length of Roots (cm)

Table1 showed that the length of roots and fresh weight of root were recorded significantly (P<0.05) maximum in the sample collected from Mianwali. While, the sample collected from kala-Bagh showed minimum root lengths and fresh weight of roots. Our results are favored by (Shapla *et al*., 2014; Khatun *et al*. (2012). The possible explanation of the results is that there is a great variation in the soil composition and electrical conductivity which strongly influenced the fresh weight and dry weight of rots and length of roots (Ding *et al*., 2018).

Proximate compositions

The proximate compositions of different ecotypes of *Brassica oleracea* L. are presented in Fig. 1.

Moisture content (%)

The significantly (P<0.05) highest moisture content (93.34%) was recorded in the sample of Isa- khail followed by (90.22%) in sample of Kala-Bagh and then (89.75%) in sample of Mianwali.

The lowest values (78.57%) of the moisture contents were recorded in the sample of Sultan-Khail. The results were significant at (P<0.05) among different ecotypes of *Brassica oleracea* L. The products that has low values of fats usually higher values of moisture contents. The sample of Isa-khail has higher values of moisture contents as the soil is better as compared to other cities and possible climates are much better, while the soil of sultan-khail is concentrated with stones and it is hilly area so we can say that's why this sample has much lower values of moisture contents. Moisture content is efficient parameter that is used in testing of foods. The higher values of moisture indicated that cabbagehas less shelflife. (Adepoju, 2006).

The highermois ture contents were confirmed with the findings of (Baloch *et al.,* 2015), which a higher moisture contents (90.62%) were reported in *Brassica oleracea* and (81.38%) in Kale by (Emebu *et al.*, 2011). The higher moisture values for vegetables like *Pterocarpus santalinoides* (80.75%) and *Gnetum africanum* (83.75%) also reported by (Ekumankama, 2008). (Fig.1A).

Total Ash (%)

The (Fig.1B) showed that significantly (P<0.05) maximum total ash values (19.67%) were recorded in the sample of Mianwali followed by (19.17%) in sample of Isa-Khail and then sample of kala-Bagh (18.31%). However, lowest values (17.37%) were recorded in the sample of Makerwal. The results of total ash contents were significantly different at (P<0.05). The findings of the present study are supported by the findings reported in cauliflower by (Baloch *et al.,* 2015) and in Kale by (Emebu *et al.*, 2011).

Crude fiber (%)

The highest values (21.28%) of crude fiber were recorded in the sample of Mianwali followed by (20.88%) in sample of Isa-Khailand then sample of Makerwal (20.69%). However, lowest values (18.30%) werere corded in the sample of Kala-Bagh. The results showed that values of crude fiber were significantly different at (P<0.05). *Brassica oleracea* is an efficient source of fiber and fiber has a key role in lowering cholesterol level by cleansing the digestive tract, risk of heart diseases, diabetes, colonand breast cancer. Fiber also helps tocontrol blood sugar level undercontrol, (Ishida *et al.*, 2000; Rao and Newmark, 1998). The higher values of crude fiber (29.61%) in *Hibiscus cannabinus* and *Haematos taphisbarteri* were reported by (Kubmarawa *et al.*, 2009).

Our results are also in conformity with the Bangash *et al.*, 200, Oulai Patricia *et al.*, 2014. The electrical conductivity strongly affects the crude fiber and electrical conductivity as mentioned in table 2 is different in all ecotypes soil. (Ding *et al.*, 2018). (Fig. 1C).

Table 2. Ecotypes Soil analysis (mean value± SE).

Ecotypes	Soil texture	Water holding capacity	Organic matter	pH	Electrical conductivity
Mianwali	Loamy	1.42±0.18	0.70±0.08	6.2±0.14	1.8±0.2
Isa-khail	Loamy	1.38±0.26	0.67±00	6.5±0.32	1.8±0.16
Kala-Bagh	Sandy Loam	1.13±0.22	0.48±0.06	7.2±0.23	2.4±0.31
Sultan-Khail	Loamy	1.32±0.14	0.65±0.02	6±0.20	1.6±0.24
Makerwal	Sandy Loam	1.19±0.11	0.54±0.01	6.5±0.19	1.4±0.12

Crude protein (%)

The results revealed that significant (P<0.05) maximum values (29.043%) of crude protein were recorded in the sample of Mianwali followed by (26.82%) in sample of Isa-Khailand then sample of sultan-Khail (25.78%). However, lowest values (24.80%) were recorded in the sample of kala-Bagh. The values of crude protein for all ecotypes were statistically significant at (P<0.05). Our results are in conformity with the findings of Baloch *et al.,* 2015 in Cauliflower and in Kale by (Emebu *et al.*, 2011). *Brassica oleracea* is a good source of vegetables

protein and have higher amount of proteins and these values are higher than 3.3% reported by USDA nutrient database for standard references (Hall, 1998). The protein Values makes the cabbage as a better vegetable for consumption of body needs. The crude protein is strongly difference in all ecotypes and possible justification of these results is the difference in soil composition and soil electrical conductivity. (Fig. 1D).

Fats %

The findings of recent study as mention in (Fig.1E). showed that the significantly (P<0.05) highest values (1.92%) of fats were recorded in the sample of Sultan-khailfollowed by (1.46%) in sample of Makerwal and then sample of Mianwali (1.09%). However, lowest values (0.38%) were recorded in the sample of kala-Bagh. The values of fats for all ecotypes were statistically significant at (P<0.05). Similar findings were also reported by Onwordi *et al.*, 2009; Baloch *et al.,* 2015; Emebu *et al.*, 2011. Fats are important for human health and *Brassic aoleraceais* avitalsource of vegetablesbase diet. Fats stored energy and protects the body and carry fats soluble vitamins like Vitamin (A, D, E & K) and also provide cholesterol a precursor for hormones (Insel *et al.*, 2004).

The possible justification of the results of recent study is the difference in the soil structure and soil texture. The soils water holding capacity, Organic matter, pH and Electrical conductivity is varied as detail is mentioned in table 2.

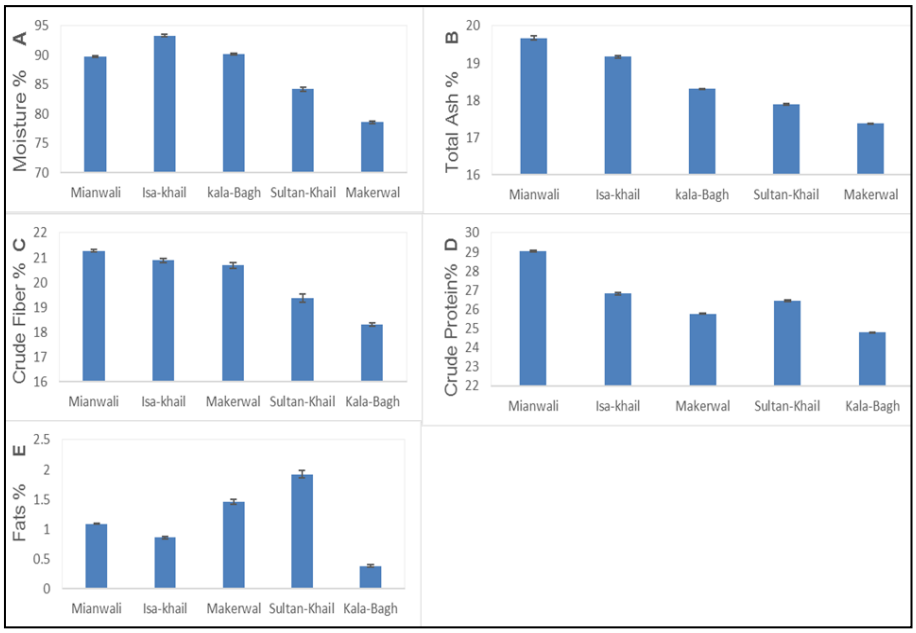

Fig.1. Proximate Composition (A) Moisture contents, (B) total ash, (c) crude fiber, (D) Crude protein), (E) Fats of *Brassica oleracea* L. different ecotypes**.**

Conclusion

It is concluded from the recent study that *Brassica oleracea* L. is a great source of crude fiber, crude protein and fats. The growth and proximate composition is strongly influenced by soil texture and soil composition.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgment

The authors are thankful to Mr. Fakhar Abbas Khan to analyze the data statistically.

References

Adepoju OT, Oyewole OE. 2008. Nutrient Composition and Acceptability Study of Fortified Jams from *Spondias mombin* (Hog Plum, Iyeye in Yoruba) Fruit Pulp. Nigerian Journal of Nutritional Science **29(02),** 180-9.

AOAC. 1990. Official methods of analysis of the Association of Official Analytical Chemists, 15th ed., Association of Official Analytical Chemists, Arlington VA, pp. 1058-1059.

AOAC. 2000. Official methods of analysis of AOAC International, (17th ed.), Gaithersburg, MD, USA: AOAC.

Baloch AB, Xia X, Sheikh SA. 2015. Proximate and Mineral Compositions of Dried Cauliflower (*Brassica oleracea* L.) Grown in Sindh, Pakistan. Journal of Food and Nutrition Research **3(3),** 213-9.

Bangash JA, Arif M, Khan MA, Khan F, Hussain I. 2011. Proximate composition, minerals and vitamins content of selected vegetables grown in Peshawar. Journal of the Chemical Society of Pakistan **33(1),** 118-22.

Ding X, Jiang Y, Zhao H, Guo D, Zhou Q, Nandwani D, Hui D. 2018. Electrical conductivity of nutrient solution influenced photosynthesis, quality, and antioxidant enzyme activity of pakchoi (*Brassica campestris* L. ssp. Chinensis) in a hydroponic system. PloS One **29,** 13(8).

Ekumankama IO. 2008. Nutrient composition of indigenous vegetables (*Pterocarpus soyanxii, Pterocarpus santalinoide s*and *Gnetum africanum*). Nigerian Journal of Nutritional Sciences **29,** 195-200.

Emebu PK, Anyika JU. 2011. Proximate and mineral composition of kale (*Brassica oleracea*) grown in Delta State, Nigeria. Pakistan Journal of Nutrition **10(2),**190-4.

FAO. 2017. Food and agriculture organization corporate statistical database; food and agriculture data; production crop.

Hall R. 1998. Kale (*Brassica oleracea)*, USDA Data Basefor Standard Reference. Nutrition Guide.

Hesse PR. 1971. A textbook of soil chemical analysis.

Karthika VP, Ajithkumar B, John CL. 2016. A Fundamental Study to Identify the Suitable Cropping Period for Cauliflower (*Brassica oleracea* var. botrytis) and to assess the Impact of Various Weather Parameters on its Cultivation in Central Kerala. Research Journal of Agricultural Sciences **7(4/5),** 783-6.

Khatun K, Hossain F. 2012. Effect of different transplanting dates on the growth and yield of broccoli. Journal of Experimental Biosciences **3(1),** 13-18.

Kubmarawa D, Magomya AM. 2009. Proximate composition and amino acid profile of two non-conventional leafy vegetables (*Hibiscus cannabinus* and *Haematos taphisbarteri*). African Journal of Food Science **303(9),** 233-6.

Mariga IK, Mativha L, Maposa D. 2012. Nutritional assessment of a traditional local vegetable (*Brassica oleracea* var. *acephala*). Journal of Medicinal Plants Research **96(5),** 784-9.

McKeague JA. 1978. Manual on soil sampling and methods of analysis. Canadian Society of soil Sciences 66-68.

Onwordi CT, Ogungbade AM, Wusu AD. 2009. The proximate and mineral composition of three leafy vegetables commonly consumed in Lagos, Nigeria. African Journal of Pure and Applied Chemistry **303(6),** 102-7.

Patricia O, Zoue L, Megnanou RM, Doue R, Niamke S. (2014). Proximate composition and nutritive value of leafy vegetables consumed in Northern Cote d'Ivoire. European Scientific Journal **10(6).**

Patricia O, Zoue L, Megnanou RM, Doue R, Niamke S. 2014. Proximate composition and nutritive value of leafy vegetables consumed in Northern Cote d'Ivoire. European Scientific Journal **110(6).**

QamarS, Saif A, Raza M. 2017. Effect of different pests on the crop of *Brassica oleracea* (Cauliflower) in Faisalabad. Journal of Biodiversity and Environmental Sciences **11,** 157-163.

Rao CV, Newmark HL, Reddy BS. 1998. Chemopreventive effect of squalene on colon cancer. Carcinogenesis **19(2),** 287-290.

Reza MM, Islam M, Hoque MA, Sikder RK, Mehraj H. 2017. Growth and Yield Response of *Brassica oleracea* var. *italica* to Different GA3 Application Time. BAOJ Biotech **3,** 024.

Richards LA. 1954. Diagnosis and improvement of saline and alkali soils, USDA Agric Handbook 60. Washington D.C.

Sari N, Yildiz Dasgan H, Abak K. 2000. Effects of sowing times on yield and head size of broccoli grown in the GAP Area, Turkey. Acta Horticulturae **533,** 299-305.

Sermenli T, Mavi K, Yilmaz S. 2011. Determination of transplanting dates of broccoli (*Brassica oleracea* L. *italica* plenck) under Antakya conditions. Journal of Animal and Plant Sciences **21(4),** 638-641.

Shapla SA, Hussain MA, Mandal MS, Mehraj H, Uddin AJ. 2014. Growth and Yield of Broccoli (*Brassica oleracea* var. *italica* L.) to different planting times. International Journal of Sustainable Crop Production 9(2), 29-3.