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BIOCHEMICAL ANALYSIS AND COMPARISON OF SUPERIOR CABBAGE GENOTYPES GROWN IN PLAINS AND HILLS OF KERALA, INDIA

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Abstract: The present study was undertaken to identify the superior cabbage genotype and to examine their physical yield performance among the four cultivated genotypes namely Namdhari Seeds 183, Namdhari Seeds 160, Namdhari Seeds 35 and Tropical Sun Plus, grown in plains and higher altitude of Kerala. Study revealed that significant differences were observed in yield levels of cabbage and it was ranged from 22.6 – 29.3 kg /16m^2 in hills and 1.27 – 22.06 kg /16m^2 in plains. Among the cabbage genotypes, NS 183 was found to be the best for hilly region in terms of higher head yield (22.06 Kg /16m^2), head weight (729.6 g), head height (11.1 cm) and early maturity. Similarly, Tropical Sun Plus exhibited better performance in plains in terms of higher head yield (22.06 Kg /16m2), head weight (729.6 g) and head height (11.1 cm). The individual genotype which exhibited the superior performance in hills and plains were selected and compared for the general biochemical characters like Moisture content, acidity, ascorbic acid, protein, phosphorus, calcium and potassium. Finally, the study found that, the genotype grown at hill (Tropical Sun Plus) was recorded a higher biochemical characters than genotype grown in plains (Tropical Sun plus). Similarly, hill grown genotype (NS 183) recorded a higher biochemical characters than the plains grown genotype (NS 183).

1. INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata* L., 2n= 2x= 18) belongs the family Cruciferacea is used as a green leafy vegetable and it termed as head. It is one of the most important Cole crops grown under temperate to tropical climate conditions for its head in more than ninety countries throughout the World (Singh *et al.*, 2010). Cabbage is grown in all over the agro climatic zones of India and accounting for a production of 85.34 lakh tonnes with area of 3.72 lakh hectares (NHB, 2014). It is a rich source of minerals like phosphorus, potassium, calcium, sodium and iron. According to Martinez *et al.* (2010) conducted study to determine and to compare the values of some physicochemical parameters (Moisture, soluble solids, titratable acidity, pH, protein, ash, vitamin C, total phenolics, chlorogenic acid, caffeic acid, p-coumaric acid, quercitin and chlorophyll) in different edible portions of white cabbages. The mean values of parameters measured in leaves were higher than those measured in stems except for moisture content. Similarly, Jagdish *et al.* (2009) studied the total phenol content and free radical scavenging activity of methanolic extracts from different brassica vegetables. The total phenol in red cabbage was found and it ranges from 18.7 to 101.30 mg gallic acid equivalent /100 g of fresh weight of cabbage. The antioxidant activity ranged from 13.1 in red cabbage to 2.8 µ moles trolox equivalents

per gram in white cabbage fresh sample. The linear regression analysis of data showed a significant positive correlation between total phenolic contents and free radical scavenging capacity. Based on above studies, the challenging biochemical comparative study has taken into account between hills and plains grown genotypes, which was found to be the better genotype in the expression of biochemical characters.

2. MATERIALS AND METHODS

Experimental material comprised of four genotypes namely Namdhari Seeds 183, Namdhari Seeds 160, Namdhari Seeds 35 and Tropical Sun Plus. All four cabbage genotypes have simultaneously raised in the plains of Agriculture Research Station, Department of Horticulture, Mannuthy and hills of Orange and Vegetable farm, Nelliyampathy during the winter season of 2009 to 2011. Each genotype was planted in a plot having 8.0 × 2.0 m area in randomized block design with five replications. There were 44 plants in each plot planted at 60 × 60 cm spacing. All the standard package of practices and plant protection measures were timely adopted to raise the crop successfully. Ten randomly selected plants from each replication were utilized for recording observations of physical characters viz., days to maturity, curd height (cm), curd weight (kg), curd solidity and curd yield (t/ha). The individual genotype which exhibited the superior performance both in hills and plains were selected and compared them for biochemical characters like Moisture content, acidity, ascorbic acid, protein, phosphorus, calcium and potassium. The moisture content of cabbage was determined by using a digital moisture meter model manufactured by Ohaus (Model MB 45). Acidity of cabbage was determined by titration with standard sodium hydroxide (0.1N) and expressed as per cent of citric acid as per Ranganna (1997). Ascorbic acid content of cabbage was estimated by 2, 6 dichlorophenol indophenol dye method. The protein content of cabbage was determined by Lowry's method. The phosphorus content was analyzed colorimetrically as suggested by Jackson (1973), which give yellow colour with nitric acid vanadate molybdate reagent. Calcium content was estimated by Atomic Absorption Spectrophotometer from digested sample of cabbage. Similarly, potassium content was estimated by using flame photometer as suggested by Jackson (1973). Like 5ml of digested sample was made up to 50ml and read directly in flame photometer and potassium content was expressed in mg per 100g.

3. RESULT AND DISCUSSION

Among the cabbage genotypes, NS 183 was found to be the best for hilly region in terms of higher head yield (22.06 Kg /16m2), head weight (729.6 g), head height (11.1 cm) and early yield. The cabbage genotype Tropical Sun Plus exhibited better performance in plains in terms of higher head yield (22.06 Kg /16m2), head weight (729.6 g) and head height (11.1 cm). The individual genotype which exhibited the superior performance in hills and plains were selected and compared the general biochemical characters (Table 1). The constituents analysed were moisture, acidity, ascorbic acid, protein and minerals (phosphorus, calcium and potassium). Cabbage genotype, TSP recorded 90.59% of higher moisture content when grown in plains (85.63%) as compared to hills. Similar changes of moisture content were also noticed in NS 183 recorded 87.69% and 89.86% grown under hills and plains respectively (Table 2.). Likewise, NS 183 (0.144%) from hills recorded higher acidity content than NS 183 (0.104%) from plains. The acidity of cabbage genotypes TSP from hills and plains was 0.120% and 0.071% respectively. Haque *et al*. (2005) suggested that titratable acidity of cabbage depends on the time of planting, cultivars and location. Therefore altitude may influence the acidity of cabbage grown under different locations.

Significantly higher content of ascorbic acid was observed in hill grown TSP (42.6 mg/ 100g) compared to plain grown TSP (12.92 mg/ 100g). The ascorbic acid of NS 183 from hills and plains was 51.80 and 17.92 mg/ 100g respectively. Martinez *et al.* (2010) suggested that ascorbic acid content varied according to the cultivars and location specific. Similar kinds of observations were also reported by Kadam *et al*. (2008) and Abusalem (2007). There was noticed significant reduction in ascorbic acid content when during storage. After one week of storage considerable reduction in

ascorbic acid content, which were 37.67 mg/ 100g and 31.48 mg/ 100g in hills grown NS 183 and TSP respectively. Lee and Kader (2000) and Podsedek (2007) reported that ascorbic acid is very sensitive to storage condition and it varied depending on temperature, humidity, oxygen and carbon dioxide content. Similarly, Opatova *et al*. (2003) suggested that retention of ascorbic acid varied from 50 to 70% and the losses increased when storage duration is increases.

Significant variation was observed in protein content where between hill and plains grown TSP is 0.80 g/ 100g and 0.65 g/ 100g respectively. Similarly, hill grown NS 183 recorded higher protein content than plain grown NS 183. According to Srisangnam *et al*. (2007) the higher leaf protein content may due to prevailing favorable climate particularly rainfall and better irrigation or due to the residual effect of soil nutrients from previous growing season. Phosphorus content was comparatively high in NS 183 grown in hills are 16.20 mg/ 100g. Similarly, TSP grown in hill was containing more amount of Phosphorus than plains. Cabbage genotype TSP from plains recorded higher calcium content (110.02 mg/100g) than hills (73.03 mg/100g). No significant difference was observed in case of potassium content between hill and plains grown genotypes NS 183 and TSP. Similar kinds of observation were also noticed by Watt and Wood (1963). Therefore, NS 183 and Tropical Sun Plus grown under hills were found to be a superior in nutritive value with higher content of vitamin C and minerals like phosphorus and potassium.

4. CONCLUSION

The biochemical constituents (moisture, acidity, ascorbic acid, protein and minerals) of the best performing genotypes identified both from hills and plains in cabbage were analysed. The cabbage genotype NS 183 from hills recorded comparatively higher values of biochemical constituents like acidity (0.144%), ascorbic acid (51.80 mg/100g), protein (0.73 g/100g), phosphorus (26.23 mg/100g) and potassium (200.23 mg/100g). Similarly, Tropical Sun Plus from hills also recorded the higher value of biochemical constituent. In recent past cultivation of cabbage extended to plains of Kerala, India also. In view of above finding genotype, Tropical Sun Plus is performing well in both plains and hills of Kerala as compared to NS 183 and also it having considerable value of biochemical constituent which is more immense value to the farming community.

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Table 1. Biochemical characteristics of Tropical Sun Plus grown in hills and plains

Sl. No.	Characters	TSP from hills	TSP from plains	t value
1	Moisture content (%)	85.63	90.59	3.4468**
2	Acidity (%)	0.120	0.071	7.9623**
3	Ascorbic acid (mg/100g)			
	i) Before storage	42.60	12.92	21.650**
	ii) After one week of storage	31.48	9.17	24.501**
4	Protein (g/100g)	0.80	0.65	2.3214**
5	Phosphorus (mg/100g)	28.04	14.45	41.041**
6	Calcium (mg/100g)	73.03	110.02	31.9645**
7	Potassium (mg/100g)	202.13	197.15	Ns

** Significant
Ns- Non significant

Table 2. Biochemical characteristics of NS 183 grown in hills and plains

Sl. No.	Characters	NS 183 from hills	NS 183 from plains	t value
1	Moisture content (%)	87.69	89.86	2.3254**
2	Acidity (%)	0.144	0.104	5.1230**
3	Ascorbic acid (mg/100g)			
	i) Before storage	51.80	17.92	21.660**
	ii) After one week of storage	37.67	7.17	24.561**
4	Protein (g/100g)	0.73	0.84	1.5452**
5	Phosphorus (mg/100g)	26.23	16.20	31.045**
6	Calcium (mg/100g)	42.41	76.00	36.505**
7	Potassium (mg/100g)	200.23	183.14	Ns

** Significant
Ns- Non significant

Abbreviation:
TPS- Tropical Sun Plus
NS- Namdhari Seeds
Ns- Non significant

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