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STUDIES ON THE PERFORMANCE OF DIFFERENT GENOTYPES OF CABBAGE GROWN IN PLAINS AND HIGHER ALTITUDE OF KERALA

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ABSTRACT
Cabbage is grown in all the agro climatic zones of India, accounting for an area of 3.69 lakh hectares with production of 79.4 lakh tonnes (NHB, 2011). Hence, studies are to be undertaken to identify genotype and analyze the physical characteristics among the cultivated genotypes (Namdhari Seeds 183, Namdhari Seeds 160, Namdhari Seeds 35 and Tropical Sun Plus) grown under hills and plains of Kerala, India. In this study, significant differences were observed in yield of cabbage which 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 early yield and yield attributes. The cabbage genotype Tropical Sun Plus exhibited better performance in plains in terms of high head yield (22.06 Kg /16m^2), head weight (729.6 g) and head height (11.1 cm). In general, harvest maturity was delayed by 39 – 45 days in the plains as compared to higher altitudes. The cabbage genotypes which exhibited superior performance in hills and plains were selected for further sensory evaluation studies. In this study cabbage genotype Tropical Sun Plus recorded superior organoleptic qualities when grown in plains than hilly region. However in the case of genotype NS 183, the differences in sensory qualities between produce from hills and plains were not significant.

KEY WORD: Cabbage, Genotypes, Physical character, Comparison, Performance, Yield attributes, Sensory quality.

INTRODUCTION

Cabbage (*Brassica oleracea* var. *capitata* L., 2n= 2x= 18) of the family Brassicaceae or Cruciferacea is used as a green leafy vegetable. 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). It is a rich source of minerals like phosphorus, potassium, calcium, sodium and iron. It is grown in all the agro climatic zones of India, accounting for an area of 3.69 lakh hectares with production of 79.4 lakh tonnes and it's grown throughout the country but is more popular in southern states where it is available all the year (NHB, 2011). In northern India also, the cabbage availability period has been considerably extended with the development of tropical varieties or hybrids. Cabbage is a thermo sensitive crop. It loses its flavour in dry warm weather condition. Optimum temperatures required for the cultivation of cabbage in plains is 28 to 30^{o}C and in hilly areas are to 23^{o}C. Mckeown *et al.* (2004) reported that yield of cabbage decreased with warmer average temperature and number of days was found to above 30°C with fewer days of precipitation. Higher temperatures probably will increase heat related quality disorders and possibly reduce vitamin content. Cervenski *et al.* (2002) evaluated 12 divergent cabbage genotypes and reported highly significant interactions for head mass, usable portion of head, core length and yield. In recent past the cultivation of cabbage is being extended to the plains from higher altitude of Kerala. As the genotype interacts considerably with the environment in which they are grown and identification of genotype which performs well in the plains will be immense value to the farmer. Hence, studies are to be undertaken to identify genotypes with appreciable yield and yield attributes of produce and organoleptic quality.

MATERIAL AND METHODS

Experimental material comprised of four genotypes namely NS183, NS160, NS 35 and Tropical Sun Plus. Cabbage genotypes was 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 viz., days to maturity, head height (cm), head weight (kg), head solidity, head yield (t/ha) and sensory attributes of selected genotypes (Hedonic scale).

RESULTS & DISCUSSION

Isenberg *et al*. (1975) considered attaining the maximum head size as an index of cabbage maturity. Accordingly cabbage maturity was recorded by observing compactness and maximum size of the head. The cabbage genotype, NS 183 matured early in hilly region whereas in the plains it took longer time (30 -33 days) to reach harvest maturity (Fig. 1). The NS 183 recorded the highest head yield (29.3 Kg /16m^2 plot) in hilly region (Fig. 2). In plains, TSP recorded the highest yield (22.06 kg /16m^2 plot) among the different genotypes. According to Meena *et al.* (2010)

yield and its component characters are polygenic in nature, hence influenced by the environmental factors. The genotypes, NS 183, NS 160 and NS 35 did not perform well in the plains which is evident from the low yield recorded ranges from 1.27 -1.38 Kg /16m^2. Kahn *et al.* (2007) stated that temperatures above 30^{o}C are not suited for cabbage production in plains.

Variation in yield and yield attributes of cabbage from hills and plains

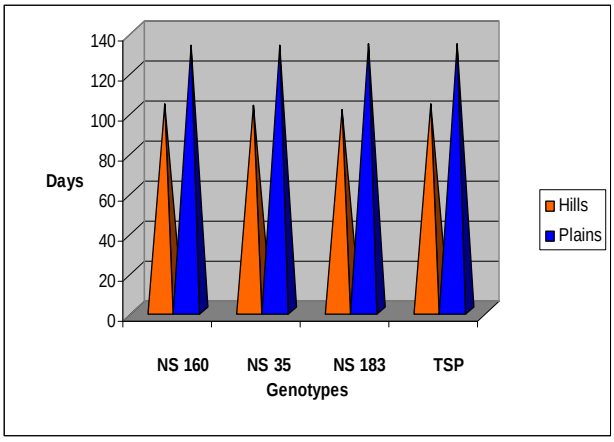

FIGURE 1. Days to maturity

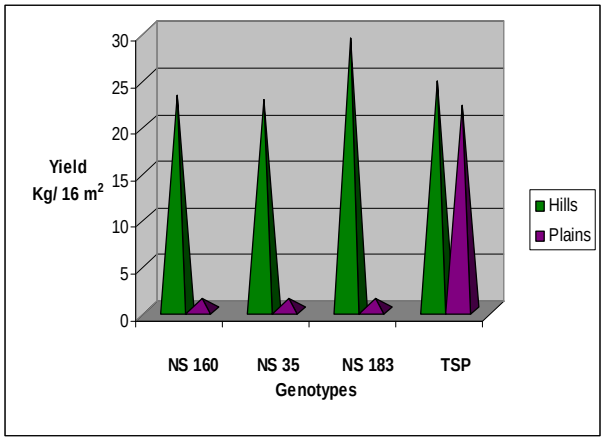

FIGURE 2. Head yield

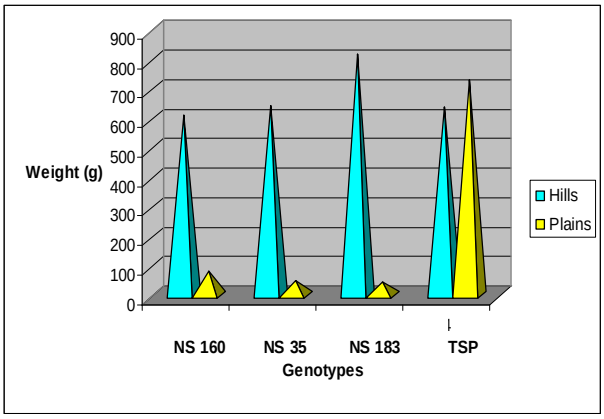

FIGURE 3. Head weight

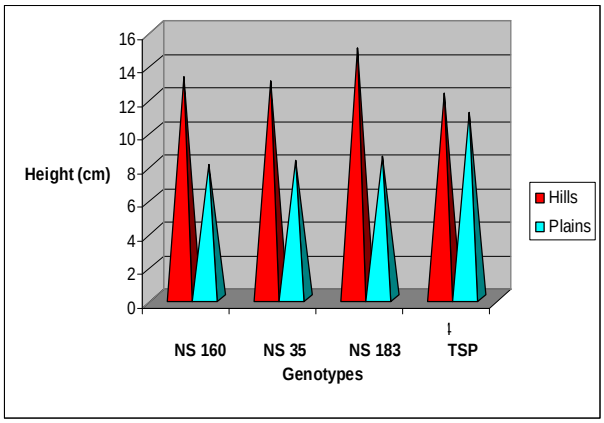

FIGURE 4. Head height

The results of the present study pointed out that temperature is an important factor contributing to head yield. The critical duration of high temperature exposure ranged from 27.5^{o}C and 37.4^{o}C and caused limited growth in cabbage. The recorded head weight and head height of NS 183 was 816.8 (g) and 14.96 (cm) respectively in hilly region. TSP recorded highest head weight (729.6 g) and head height (11.1 cm) compared to all the other genotypes raised in plains (Fig. 3 and 4). This may due to lack of efficient utilization of limiting factors like nutrients, light, air and moisture. Ghosk and Gulati (2001) reported that temperature had a significant effect on cabbage head shape as indicated by average head length/ width ratios. In case of density is a measure of solidity and is most frequently employed as an indicator of maturity. In all the genotypes no significant difference was noticed in terms of head solidity for both the regions.

Among the cabbage genotypes which exhibited superior performance in hills and plains were selected for further sensory evaluation studies. In this studies separately analysed sensory evaluation for before storage (fresh produce) and after one week of storage. In general, before storage produce giving good organoleptic quality than in after one week of storage. Higher mean score of colour (4.66), taste (4.5), flavour (4.6) and texture (4.3) was recorded for the genotype TSP from the plains. Yano *et al.* (1990) reported that plains grown genotypes contain more sugar content than hills because of high concentrations of sulfur containing glucosinolates, which influence the perception of sweetness. However in the case of NS 183 higher score for taste was obtained from hills, but the difference was not significant (Table 2). The variety, plant spacing and planting date affect a wide range of organic compounds associated with cabbage flavour. Highest mean score for texture was observed in plains of TSP which may be due to better dry matter and sugar accumulation resulting in better texture in plains as reported by Suojala, 2003. Buike and Alsina (2003) suggested that calcium is one of the most important nutrients responsible for improving the sensory quality of cabbage texture. Among the cabbage genotype TSP recorded superior organoleptic qualities (colour, taste, flavour, texture and overall acceptability) when grown in plains than in hilly region (Table 1). From above finding it may be concluded that genotype TSP giving good physical and organoleptic quality in plains of Kerala, whereas NS 183 showing better performance but not in sensory quality in higher altitude of Kerala.

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TABLE 1. Mean scores for organoleptic qualities of cabbage, genotype Tropical Sun Plus

Character	Colour			Taste			Flavour			Texture			Overall acceptability		
Region	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value
Hills	4.16 (1.25)	3.26 (1.35)	13.5**	3.5 (1.08)	2.6 (1.02)	4.92**	3.3 (1.17)	2.5 (1.15)	5.43**	3.6 (1.17)	2.8 (1.25)	6.53**	3.98 (1.0)	3.01 (1.0)	97.0**
Plains	4.66 (1.75)	3.73 (1.75)	46.5**	4.5 (1.92)	3.6 (1.95)	3.89**	4.6 (1.83)	3.7 (1.83)	3.53**	4.3 (1.83)	3.5 (1.75)	4.61**	4.75 (2.0)	3.75 (2.0)	63.2**
Kendall's W (a)	0.5	0.7		0.83	0.85		0.66	0.76		0.5	0.5		1.0	1.0	
% Significant	0.083	0.073		0.025	0.027		0.046	0.051		0.083	0.083		0.014	0.016	

Mean significant at 5% level

TABLE 2. Mean scores for organoleptic qualities of cabbage, genotype NS 183

Character	Colour			Taste			Flavour			Texture			Overall acceptability		
Region	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value	Before Storage	1 week after storage	t value
Hills	2.8 (1.33)	2.1 (1.31)	4.42**	3.6 (1.67)	3.1 (1.65)	2.67**	3.1 (1.58)	2.1 (1.48)	7.74**	3.1 (1.58)	3.1 (1.58)	+	3.1 (1.42)	3.03 (1.43)	NS
Plains	3.16 (1.67)	2.19 (1.62)	35.4**	3.0 (1.33)	2.7 (1.35)	NS	3.0 (1.42)	1.9 (1.32)	2.39**	2.8 (1.42)	2.12 (1.23)	90.3**	3.04 (1.66)	2.85 (1.63)	NS
Kendall's W (a)	0.33	0.38		0.16	0.18		0.03	0.029		0.05	0.051		0.03	0.04	
% Significant	0.15	0.17		0.31	0.34		0.65	0.66		0.56	0.53		0.65	0.80	

Values in parenthesis are mean rank scores
** = Significant at 1% level
+ ='t' test not performed as all observation were equal
NS = Non significant
t value = test value

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