

Evaluation of Hybrid Cabbage (*Brassica oleracea* L.) Varieties on Yield and Quality in Gamo Zone, Sothern Ethiopia

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ABSTRACT

A field experiment was conducted at Gircha fruit and vegetable research centre, in Chenchha district in Belg and Kiremit seasons under rain fed condition and the area receives 1150 mm average annual rainfall and the soil is acidic with clay loamy texture. The experiment was conducted to evaluate hybrid cabbage varieties for yield and quality. Four hybrid head cabbage varieties Landini, Victoria 500 and widely cultivated Copenhagen market arranged in complete block design (RCBD) with three replications. Results show that a wide range of variation was observed among cabbage genotypes for yield and quality parameters. Landini variety had the highest head weight (2.86 kg, 2.9 kg), marketable yield (51 t/ha, 52.08 t/ha) and head diameter (24.36 cm, 26.91 cm) followed by victoria variety in Belg and Kiremit seasons, respectively. On the other hand, in both seasons, victoria variety had the highest total soluble solid. Whereas, 500 variety exhibited the lowest yield and quality traits, except for head firmness. Therefore based on the results, Landini variety exhibit good yield attributes and can be recommended for Chenchha and other similar agro-ecologies. However, further study needed over location, by adding more varieties and other management practices to come up with wider recommendations.

Keywords: Cabbage; Hybrid variety; Yield; Quality

INTRODUCTION

Background and justification

Cabbage (*Brassica oleracea* L.) is a member of the *Brassicaceae* family and is originated in Northern Europe, the Baltic Seacoast. The crop is grown in diverse altitude ranging from 500 to 3000 masl. Cabbage can be grown in wide range of soils from light sandy to heavy clay soils with high organic matter content and good source of nitrogen, phosphorous, and potassium. The ideal temperature ranges from 15°C-20°C is for good growth and quality head formation. Cabbage is good source of protein, fibre, vitamins and minerals like. In Ethiopia, cabbage is cultivated on 38,000 hectares of land under irrigation and rain fed condition. In addition, Ethiopian cabbage known as kale, potato and Swiss chard are dominantly cultivated in cool area of the country. Although, different vegetables are grown in Ethiopia but vitamins and mineral deficiencies are very common problem in the country Andinet, 2016. This can be due to limited habit of

fruit and vegetable consumption in one hand and heavy dependence on cereals on the other hand [1].

Nevertheless, in Ethiopia, production and productivity of cabbage is very low (10 t/ha) and limited in small area due to several factors such as inappropriate agronomic practice, lack of improved and adaptable varieties to different environmental condition, disease and insect pest and poor post-harvest handling practice to mention a few. Furthermore, cabbage varieties which are open pollinated that was widely cultivated in Ethiopia, and those open pollinated variety for instance, Copenhagen market has been rapidly replaced by many exotic hybrid varieties without testing yield and quality performance in different environmental conditions. And also, in the study area (in Gamo highlands) information on the local adaptation and performance of cabbage varieties are limited. The area has vast land and suitable agro-ecology to produce cool season vegetables in general and head cabbage in particular. Therefore, selecting suitable head cabbage varieties are important for successful selection of suitable genotypes to the local environment

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Received: 28-Mar-2022, Manuscript No. horticulture-23-16453; **Editor assigned:** 01-Apr-2022, PreQC No. horticulture-23-16453 (PQ); **Reviewed:** 15-Apr-2022, QC No. horticulture-23-16453; **Revised:** 04-Apr-2023, Manuscript No. horticulture-23-16453 (R); **Published:** 02-May-2023, DOI: 10.35248/2376-0354.23.10.1000005

Citation: Samuel H (2023) Evaluation of Hybrid Cabbage (*Brassica oleracea* L.) Varieties on Yield and Quality in Gamo Zone, Sothern Ethiopia. J Hort. 10:005.

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conditions. Furthermore, as Cabbage is highly perishable vegetable, its market demand is dependent on quality of heads such as firmness and free from defects. Therefore, it is appropriate to select varieties which can fulfill both yield and quality parameters. Therefore, the objective of this study was to evaluate hybrid cabbage varieties based on yield and quality attributes [2,3].

MATERIALS AND METHODS

Description of the study area

The study was carried out at Gircha fruits and vegetables research centre located in Gamo highlands of Chench district, Southern Ethiopia (6019'0"N latitude and 37035'0"E longitude with altitude range of 3007 masl). The topography of the study area is hilly, with slope of 13% and the texture of the soil is clay loam with the pH of 4.8. The annual rain fall distribution varies from 900 mm-1200 mm. The rainfall pattern is bi-modal, allowing two cropping seasons in a year (i.e., the long and the short rains). And the minimum and maximum temperature of the area is 12°C and 23°C [4].

Experimental design and treatments

The experimental comprised four treatments and each treatment randomly assigned in each block and replicated three times in Randomized Complete Block Design (RCBD). The treatment consist four varieties namely Victoria, Landini, 500 and Copenhagen market. Copenhagen market was included as check. The seeds of the varieties were sown in Belg (February-May) and Kiremit (June-September) cropping seasons. The spacing between plots and blocks is 1 m and 1.5 m respectively. The spacing between plant and row is 40 cm and 60 cm. The size of each experimental (plot) is 6 m².

Experimental procedures

The experimental land was prepared by ploughing, levelling and harrowing for better seedling establishment. After 35 days healthy of nursery phase, vigorous and succulent seedling was selected and transplanted to the main field. Replanting to replace dead or weak seedlings in main field was done a week after transplanting. All recommended agronomic practices were equally applied to all plots. At the end of the experiment, five heads cabbage were harvested for yield and quality evaluation [5].

Data collection

Head weight: Was measured from five plants using sensitive balance and the mean value expressed in kilo gram.

Marketable yield: The heads which free from insect pest and disease are considered as marketable yield

Head diameter: By cutting head equally and measured by digital caliper and expressed in cm and the mean considered for statistical analysis.

Head firmness: The head firmness was measured using a hand held penetrometer (model FT327, QA Supplies, LLC, USA), probe no. 16, by exerting pressure on the heads. The reading in force (kg) at which the cabbage head was punctured.

Total soluble solids: TSS was determined by following procedures described by Waskar, et al. TSS was determined by a hand refractometer (Model RHB 32ATC) with a range of 0% to 32% brix by placing 1 to 2 drops of clear juice extracted from the heads of cabbage on the prism. The refractometer was washed with distilled water and dried before the next measurement [6].

Data analysis

All mean values of the yield and quality were subjected to Analysis of Variance (ANOVA) using SAS statistical software 9.1.3 (SAS institute, 2004). When ANOVA showed significant differences, treatment mean separation was carried out using Least Significance Difference (LSD) at 5% level. As the effect of seasons was significant, I presented the results of Belg and Kiremit seasons separately.

RESULTS AND DISCUSSION

Yield and yield components

Head weight: The results of head weight in the both season indicated that there was significant difference ($P < 0.05$) among varieties. In Belg and Kiremit seasons, Landini variety had the highest mean head weight (2.86 kg, 2.90 kg) values, respectively. In contrast, the lowest head weight was recorded in Belg to Copenhagen market (1.81 kg) and in Kiremit to 500 (1.64 kg) varieties (Table 1). These results suggest that different varieties have different yield response in Kiremit and Belg seasons in my experimental area. This is in agreement to Cervenski, et al. who reported different cabbage varieties exhibit different response in different environmental conditions. Moreover, head weight can be used as one of the criteria to select cabbage genotypes [7,8].

Table 1: Evaluation of hybrid cabbage varieties on mean head weight and marketable yield in Belg and Kiremit seasons.

Parameters	head weight (kg/head)		Marketable yield(t/ha)	
	Belg	Kiremit	Belg	Kiremit
Treatment (cabbage varieties)				

Copenhagen market	1.81	2.1	29.66	36.52
Landini	2.86	2.9	51	52.08
Victoria	2.62	2.53	47.33	45.4
500	2.06	1.64	35	27.66
LSD (5%)	0.46	0.51	2.92	8.36
CV (%)	9.98	11.2	3.58	10.36

Marketable yield: In present study, varieties had significant effect on marketable yield. Landini variety was performed very well in both Belg and in Kiremit seasons, except the highest marketable yield (52.08 t/ha) was recorded in Kiremit season (Table 1). However, Copenhagen market and 500 varieties had the lowest marketable yield both in Kiremit and Belg seasons. Moreover, victoria and 500 varieties showed yield reduction in Kiremit but not in Belg season, may be due to high soil moisture and low temperature in Kiremit season suggesting these varieties may be sensitive to very low temperature compared with other varieties. These results are in agreement with Hasan, et al., who reported that varies cabbage genotype exhibit significant effect on marketable yield [9].

Quality parameters

Head diameter: Head diameter determines the consumer preference and has great contribution on market price of head

cabbage. Head diameter significantly ($P<0.05$) influenced by different cabbage varieties. In Belg season the longest (25.66 cm) and the shortest (20.18 cm) head diameter were registered to victoria and Copenhagen market variety, respectively (Table 3).

In Kiremit season, the highest mean diameter was recorded to Landini (26.91 cm) and the lowest mean diameter (19.73 cm) was registered to 500 varieties (Table 2). This agrees with Hasan, et al. and Olaniyi and Ojetayo, who reported that Cabbage varieties show difference in the diameter of cabbage head.

Table 2: Evaluation of hybrid cabbage varieties on mean number of head diameter and head firmness.

Treatment	Parameters			
Variety	Head diameter (cm)		Head firmness (kgf)	
Season	Belg	Kiremit	Belg	Kiremit
Copenhagen market	20.18	21	14.95	13.88
Landini	24.36	26.91	13.98	14.38
Victoria	25.66	23.66	13.23	14.08
500	21.38	19.73	16.63	17.3
LSD (5%)	2.16	2.34	1.45	1.48
CV (%)	4.74	5.13	4.94	4.99

Head firmness: The data suggested that genetic variation had a significant effect on head firmness of cabbage. In both season 500 variety performed very well and the highest mean (17.3 kgf) recorded in Kiremit season (Table 3). In contrast to this certain variety show different response to season. For instance in Belg season the lowest mean registered in victoria variety and in Kiremit season Copenhagen market. This result suggested that varieties not reflected the same way to various environmental conditions due to difference sensitivity to weather condition.

Total soluble solids: Total soluble solid is one of the quality attributes and determine the balance of sugar to acid ratio and it has significant role in flavor of head cabbage. The present finding revealed that genetic variation had significant ($P<0.05$) effect on total soluble solid of head cabbage. In both Belg and Kiremit season, the highest (7.93°brix, 7.73°brix) mean value was recorded to victoria variety followed by Copenhagen market (7.06°brix, 7.13°brix), and the lowest (5.8°brix, 5.5°brix) TSS was registered in 500 variety, respectively. This variation may be victoria varities had good stomatal conductance and nutrient

absorption capability which provides higher carbon metabolism for higher glucose production that finally converted in to total soluble solids. This result confirmed also by Tesfaye, et al., who

reported that total soluble solid of head cabbage significantly influenced by different cabbage varieties [10,11].

Table 3: evaluation of hybrid cabbage varieties on mean number of total soluble solids.

Treatment	Parameter	
Variety	Total soluble solid (obrix)	
Season	Belg	Kiremit
Copenhagen market	7.06	7.13
Landini	6.13	6.66
Victoria	7.93	7.73
500	5.8	5.5
LSD (5%)	0.57	1.13
CV (%)	4.28	8.39

CONCLUSION

In developing country like Ethiopia, consumption of vegetables including cabbage is not enough due to low yield per unit areas and low availability, especially during dry seasons. To overcome such problem, adaptation trials of high yielding hybrid varieties are very critical. Hence this study was initiated to select high yielding variety, with reasonable quality and adaptable to harsh environmental conditions. Overall data suggests that Genetic variation had significant effect on yield and quality of head cabbage. Among the tested varieties, Landini variety performed very well in term of yield component like head weight and marketable yield. However, in the area Copenhagen market was widely cultivated variety but based on the present finding farmers are recommended to use Landini variety to boost yield and quality of head cabbage. Nevertheless, the experiment was conducted with limited varieties and only in one location, similar experiment should be tested over different location and varieties.

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