Effect of Transplanting Dates on Plant growth, Yield and Quality Traits of Cabbage (*Brassica oleracea* var. *capitata* L.) Cultivars

B. K. Singh*, K. A. Pathak, K. A. Sarma and Manju Thapa

Abstract

A field experiment was under taken with an objective to examine the effects of different transplanting time on growth, yield and quality of various cabbage (*Brassica oleracea* var. *capitata* L.) varieties and hybrids in mild-tropical climate of Mizoram. All the parameters under study were significantly affected by both cultivars and transplanting dates. Maximum yield potential of various cultivars was realised by transplanting of cabbage seedlings on 1st December. The most compact head was observed for INDAM-1299 followed by Golden Acre, NS-160, KGMR-1 and lowest in Ryozeki. The head compactness is a very important parameter, which is directly associated with the transportability, marketability, shelf-life and consumers' preference. The cultivars KGMR-1 and Golden Acre (both bred by IARI Regional Station, Katrain, Himachal Pradesh) showed better head yield potential, while KGMR-1 and Ryozeki produced higher plant biomass, which could be used during summer and rainy seasons, especially for leaf production.

Key words: Cabbage, cultivars, date of transplanting, yield, Mizoram

Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.), known as zikhlum in Mizo dialect, is one of the most popular and widely grown vegetables in Mizoram for its head and tender non-wrapper leaves, and has occupied first position in production (3684 t) and second in area (236 ha) with a productivity of 15.6 t/ ha (Singh et al. 2011). The head and tender non-wrapper leaves are usually cooked and used in curry, boil, meat and soup. The old non-wrapper leaves are generally used as pig feed. Besides, having good tonnage capacity, it is a rich source of essential and sulphur containing amino acids, minerals, β-carotene and ascorbic acid. It has been reported to have anti-carcinogenic properties (Singh et al. 2009).

ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib-796081, Mizoram
[1]Corresponding author, e-mail: bksinghkushinagar@gmail.com

It stands at the fourth position in production among the vegetable crops in the world after potato, tomato and watermelon (Anonymous 2011). There is a steady demand of cabbage throughout the year due to its popularity in Mizo cuisines. During off season (summer and rainy seasons) from March-October when there is little or no heading in cabbage, the whole plants are used as leafy vegetable which is very popular among Mizo community. Hence an experiment was under taken with objective to examine the effects of different transplanting time on growth, yield and quality of various cabbage varieties and hybrids in mild-tropical climate of Mizoram. 25.50 million hectare. This region is one of the hotspot of biodiversity for crop genetic resources and neighbouring to the centre of origin for *Brassica*, *i.e.* Indo- Chinese region. Therefore, an attempt was made to collect and characterize the diversity of rapeseed- mustard germplasm especially in parts of Nagaland, Meghalaya and Assam states. Further, an attempt was made to establish the relationship with yield-related traits and to identify the promising genotypes.

Materials and methods

The experiment was carried out at the Research Farm, ICAR Research complex for NEH Region, Mizoram Centre, Kolasib, Mizoram (24.12 ºN, 92.40 ºE and 650 m above sea level) during 2009-2010. The soil type is an Alfisol and acidic (pH 5.8). The experiment was laid-out in split plot design (SPD) with three replications. The treatments comprised of five cultivars in the main-plots and three dates of transplanting (13th November, 1st December and 18th December 2009) in the sub-plots. The cultivars under study were NS-160 (hybrid,), KGMR-1 (hybrid, bred by IARI Regional Station Katrain, HP), Ryozeki (hybrid, bred by Nunhems India Ltd., Hyderabad, Andhra Pradesh), Golden Acre (variety, bred by IARI Regional Station Katrain, HP) and INDAM-1299 (hybrid, bred by IAHS Co., Bengluru, Karnataka). The uniform dose of FYM @ 6 t/ ha and lime @ 2 q/ ha was applied to the each plots at last tilling. The NPK fertilizers @ 100:50:40 kg/ ha were supplied by urea, single superphosphate (SSP) and

muriate of potash (MOP), respectively. Twenty-five days old seedlings, raised under net-house having 4-5 true leaves, were transplanted at spacing of 50×40 cm in the plot of 4×2.4 m size accommodating forty-eight plants in each. The horticultural parameters were recorded with respect to number of non-wrapper leaves, weight of non-wrapper leaves (kg), gross plant weight (kg), polar length (cm), equatorial length (cm), net head weight (kg), harvest index (%), head compactness and yield (q/ ha) on 15 randomly chosen plants in each treatment and replication. The head compactness was determined as per Pearson (1932). The data were subjected to analysis using IRRISTAT software (Version 3/93, Biometrics Unit, International Rice Research Institute, Manila, Philippines.

Results and discussions

The partitioning of estimates of analysis of variation (ANOVA) into main-plot (cultivar), sub-plot (transplanting date), and interaction between main-plot and sub-plot revealed that mean squares due to cultivars were significant for all the traits, except from head compactness, which are indicating that various cultivars are affecting the plant growth and productivity (Table 1). All the traits were also significantly affected by date of transplanting and showing the influence of environments on growth and yield of cabbage. The cultivars and their interaction with transplanting dates showed a non-significant difference for all the traits. The result corroborates the finding of Gautam et al. (2006) for all the studied traits in onion.

The leaf and plant growth (number & weight of non-wrapper leaves, and gross plant weight) was highest when the seedlings were transplanted on 1st December followed by 13th November and lowest in 18th December transplanting for all the cultivars which indicates that best suitable time for transplanting of cabbage (Table 2). The gross plant weight was highest for KGMR-1 followed by Ryozeki, NS-160, INDAM-1299 and Golden Acre. The cultivars KGMR-1 and Ryozeki did not differ significantly for gross plant weight. Moreover, the respective weight of non-wrapper leaves was observed in Ryozeki followed by NS-160, KGMR-1, Golden Acre and INDAM-1299. Therefore, the cultivar Ryozeki is popular in Mizoram during main as well as off seasons due to high biomass production efficiency.

The 2nd date of transplanting (1st December) was realized maximum polar length (length of head), equatorial length (width of head) and net head weight followed by 13th November and lowest in 18th December for all the cultivars revealing that maximum yield potential could be harnessed by transplant the cabbage seedlings around 1st December (Table 3). Maximum net head was weighed for KGMR-1 followed by Golden Acre, NS-160, Ryozeki and lowest for INDAM-1299. It is interesting to note that the equatorial length for four cultivars, namely KGMR-1, Golden Acre, Ryozeki and NS-160 were measured at par in all three transplanting dates, hence the difference in head weight is only manifested by head polar length. The harvest index was computed maximum in Golden Acre followed by NS-160, INDAM-1299, KGMR-1 and minimum for Ryozeki, which was also highest for transplanting on 1st December followed by 18th December and 13th November. Among 55 hybrids tested, Singh et al. (2009) reported that none of the hybrids articulated better harvest index over Golden Acre which is signifying the reason of being one of the superior cultivars in all over India. The head compactness, a quality trait, is very important parameter which is directly associated with the transportability, marketability, shelf-life and consumers' preference. The most compact head was observed for INDAM-1299 followed by Golden Acre, NS-160, KGMR-1 and lowest in Ryozeki, which was maximum for late transplanting (18th December) followed by early transplanting (13th November) and lowest in main season transplanting (1st December).

The yield of cabbage was significantly affected by both cultivars and transplanting dates. The highest mean yield was harvested for the cultivar KGMR-1 followed by Golden Acre, NS-160, Ryozeki and lowest yield was recorded for INDAM-1299 (Table 3). Similarly, the maximum yield was realised on 1st December transplanting date followed by 13th November and 18th December transplanting for all cultivars tested under this study. The low yield in these transplanting dates is only due to unfavourable climatic conditions. Thus it is concluded that the cultivars KGMR-1 and Golden Acre (both bred by IARI Regional Station, Katrain, HP) have the potential for better head yield, while KGMR-1 and Ryozeki produced higher plant biomass which could be use during summer and rainy seasons especially for leaf production.

Acknowledgement

We would like to express our thank to the Director, ICAR Research Complex for NEH Region, Umroi Road, Barapani, Meghalaya for his financial support for the present research work.

References

Anonymous (2011). Vegetables and Melons Outlook /VGS-346/August 25, 2011 Economic Research Service, USDA
http://www.ers.usda.gov/publications/vgs/tables/world.pdf

Gautam IP, Khatri B, Paudel GP (2006). Evaluation of different varieties of onion and their transplanting times for off season production in mid hills of Nepal. Nepal Agricultural Research Journal 7: 21-26

Pearson OH (1932). Breeding plants of cabbage group. California Agriculture Experiment Station Bulletin 532

Singh BK, Pathak KA, Boopathi T, Ramakrishna Y and Kumar S (2011). Cabbage: package of practices for cultivation in Mizoram. ICAR-RC-NEH Region, Mizoram Centre, Kolasib, Mizoram. Extension folder

Singh BK, Sharma SR, Singh B (2009). Heterosis for antioxidants and horticultural traits in single cross hybrids of cabbage *(Brassica oleracea* var. *capitata* L). Indian Journal of Agricultural Sciences 79: 703-708

Table 1: Analysis of variance (ANOVA) for leaf, head and yield parameters of cabbage

Source of variation	d. f.	Number of non-wrapper leaf	Weight of non-wrapper leaf (kg)	Gross plant weight (kg)	Polar length of head (cm)	Equatorial length of head (cm)	Net head weight (kg)	Harvest index (%)	Head compactness	Yield (q/ ha)
Replication	2	0.02	0.002	0.121	3.52	3.11	0.005	79.26	186.63	644
Main-plot (C)	4	22.77**	0.455**	0.576**	6.17**	5.89**	0.120*	560.44**	77.24	14740*
Error C	8	0.16	0.004	0.103	0.41	0.33	0.019	32.94	36.60	2257
Sub-plot (T)	2	1.44**	0.034**	0.806**	30.12**	29.97**	0.496**	73.91**	598.82**	60986**
C × T	8	0.05	0.001	0.008	0.08	0.07	0.001	6.53	5.66	164
Error T	20	0.04	0.001	0.008	0.19	0.24	0.001	5.52	13.64	129

C: cultivar, T: date of transplanting

Table 2: Effect of date of transplanting on leaf and plant growth of cabbage

Cultivar	Number of non-wrapper leaf				Weight of non-wrapper leaf (kg)				Gross plant weight (kg)			
	DOT-1	DOT-2	DOT-3	Mean	DOT-1	DOT-2	DOT-3	Mean	DOT-1	DOT-2	DOT-3	Mean
NS-160	13.40b	13.93b	13.20b	13.51b	0.617b	0.681b	0.583b	0.583b	1.670bc	1.953bc	1.514ab	1.713bc
KGMR-1	11.80c	12.30c	11.90c	12.00c	0.576b	0.616b	0.530b	0.574b	2.100a	2.279ab	1.897a	2.092a
Ryozeki	14.57a	15.33a	14.63a	14.84a	0.963a	1.054a	0.905a	0.974a	1.938ab	2.352a	1.783a	2.024ab
Golden Acre	10.53d	10.87d	10.57d	10.66d	0.455c	0.500c	0.426c	0.461c	1.506c	1.831c	1.324b	1.553c
INDAM-1299	12.23c	12.60c	11.90c	12.24c	0.395	0.428c	0.365c	0.396c	1.561bc	1.776c	1.376b	1.571c
Mean	12.51	13.01	12.44		0.601	0.656	0.562		1.755	2.038	1.579	
Estimate	SEm±		LSD at $P < 0.05$		SEm±		LSD at $P < 0.05$		SEm±		LSD at $P < 0.05$	
A	0.13		0.44		0.02		0.07		0.11		0.36	
B	0.17		0.53		0.02		0.08		0.12		0.37	
C	0.06		0.16		0.01		0.02		0.02		0.07	
D	0.12		0.36		0.01		0.04		0.05		0.15	

DOT-1: first transplanting on 13.11.2009 DOT-2: second transplanting on 01.12.2009 DOT-3: third transplanting on 18.12.2009
A: estimate between two main-plots (Cultivar) treatment means
B: estimate between two main-plots (Cultivar) treatment means at the at the same or different levels of sub-plot treatment (Date of transplanting)
C: estimate between two sub-plots (Date of transplanting) treatment means
D: estimate between two sub-plots (Date of transplanting) treatment means at the same level of main-plot treatment (Cultivar)

Table 3: Effect of date of transplanting on head size and weight of cabbage

Cultivar	Polar length of head (cm)				Equatorial length of head (cm)				Net head weight (kg)			
	DOT-1	DOT-2	DOT-3	Mean	DOT-1	DOT-2	DOT-3	Mean	DOT-1	DOT-2	DOT-3	Mean
NS-160	14.0b	15.6b	12.8b	14.1b	14.3a	15.9a	12.8a	14.3a	1.033abc	1.257bc	0.942ab	1.077bc
KGMR-1	15.3a	16.9a	13.9a	15.4a	14.4a	15.9a	13.0a	14.5a	1.186a	1.461a	1.075a	1.240a
Ryozeki	13.6b	15.0bc	12.6bc	13.7bc	14.3a	15.8a	13.2a	14.4a	0.966bc	1.217bc	0.894b	1.026bc
Golden Acre	13.9b	15.4bc	12.3bc	13.9b	14.7a	15.8a	13.0a	14.5a	1.068ab	1.351ab	0.946ab	1.122ab
INDAM-1299	13.2b	14.5c	11.7c	13.1c	12.8b	13.9b	11.2b	12.6b	0.884c	1.118c	0.782b	0.928c
Mean	14.0	15.5	12.6		14.1	15.5	12.7		1.028	1.281	0.928	
Estimate	SEm±		LSD at $P < 0.05$		SEm±		LSD at $P < 0.05$		SEm±		LSD at $P < 0.05$	
A	0.21		0.69		0.19		0.62		0.05		0.15	
B	0.30		0.92		0.30		0.92		0.05		0.16	
C	0.11		0.33		0.13		0.37		0.01		0.03	
D	0.25		0.74		0.29		0.84		0.02		0.06	

Table 4: Effect of date of transplanting on harvest index, head compactness and yield of cabbage

Cultivar	Harvest index (%)				Head compactness				Yield (q/ ha)			
	DOT-1	DOT-2	DOT-3	Mean	DOT-1	DOT-2	DOT-3	Mean	DOT-1	DOT-2	DOT-3	Mean
NS-160	62.0b	64.4b	62.3b	62.9b	36.9a	32.4a	46.5ab	38.6ab	361abc	440bc	330ab	377bc
KGMR-1	57.0bc	64.1b	57.2bc	57.2b	36.1a	33.0a	44.5b	37.9ab	415a	511a	376a	434a
Ryozeki	50.2c	51.9c	50.4c	50.8c	35.7a	33.4a	42.6b	37.2b	338bc	426bc	313b	359bc
Golden Acre	71.6a	74.0a	72.1a	72.6a	36.4a	35.7a	46.5ab	39.5ab	374ab	473ab	331ab	392ab
INDAM-1299	56.7bc	63.0b	56.9bc	58.8b	40.8a	39.4a	53.5a	44.6a	310c	391c	274b	325c
Mean	59.5	63.5	59.8		37.2	34.8	46.7		360	448	325	
Estimate	SEm±		LSD at $P < 0.05$		SEm±		LSD at $P < 0.05$		SEm±		LSD at $P < 0.05$	
A	1.92		6.24		-		-		15.84		51.60	
B	2.21		7.04		-		-		16.69		54.00	
C	0.61		1.79		0.96		6.29		2.90		8.70	
D	1.36		4.00		2.14		6.29		2.90		8.70	

DOT-1: first transplanting on 13.11.2009 DOT-2: second transplanting on 01.12.2009 DOT-3: third transplanting on 18.12.2009

A: estimate between two main-plots (Cultivar) treatment means

B: estimate between two main-plots (Cultivar) treatment means at the at the same or different levels of sub-plot treatment (Date of transplanting)

C: estimate between two sub-plots (Date of transplanting) treatment means

D: estimate between two sub-plots (Date of transplanting) treatment means at the same level of main-plot treatment (Cultivar)