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Selection of Early Cauliflower Variety for Income Generation

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Abstract
An early cauliflower genotype HRDCAU005 was developed from a mix population of Kathmandu Local variety by mess selection at Horticulture Research Division, Lalitpur, Nepal. The developed genotype was 20 days earlier than the Kathmandu Local. The performance of this genotype was evaluated in 2012 and 2013 at different locations; Lalitpur, Kavre, Dailekh and Pakhribas. The experiment was laid out in a randomize complete block design with five replications in all the years and locations. In farmers' field conditions, the highest fresh curd yield was recorded in Kathmandu Local (41.9 t/ha) followed by HRDCAU005 (29.72 t/ha) and White Flash (28.41 t/ha). Maximum attack of diamond back moth (DMB) was found in White Flash, one of the check variety, whereas the least diamond back moth attack was observed in the genotype HRDCAU005. Despite relatively low yield than Kathmandu Local variety, farmers preffered HRDCAU005 for its earliness, attractive colour, marketable curd size, good cooking quality, better taste and good market price of fresh curd.

Key words: mass selection, earliness, taste, yield, curd

Introduction
Cauliflower (*Brassica oleracea* L. var. botrytis, 2n = 2x = 18) is one of the most important vegetable crops in Nepal. The crop is very sensitive to soil and climatic requirements (Nath *et al.* 1987). Varieties also differ in temperature requirement for curd initiation (Saini 1990). In Nepal, cauliflower is the number one vegetable in terms of area cultivated and covers about 3298816 ha, which is 13% of the total area under vegetable crops. In terms of total production, cauliflower has the highest share, (491834 mt.) followed by cabbage (448980 mt) (MOAD 2012). In terms of sale, the major and common commercial vegetables are cauliflower, cabbage and tomato (CBS 2010). In Kalimati Fruits and Vegetables Market, the prices of major vegetables including cauliflower, cabbage and tomatoes have been increasing significantly every year in the month of August to November (KFVMD Board 2013). The varieties cultivated by Nepalese farmers are mostly imported hybrids. Open pollinated cauliflower varieties appropriate for August to November season are not available and farmers have been using inappropriate varieties which have resulted poor yield, quality and cash income (HRD 2006). The major problems faced by farmers during August to November are unattractive curd, poor taste and low yield. The native cultivars have some special qualities such as good taste and disease and insect tolerance (HRD 2013). Only drawback of our local varieties is the long duration (100-120 days for maturity). Hence, this varietal improvement work was designed for developing short duration genotype from our local cultivars.

Methodology
Genotype selection: To select the desirable plants, possitive approach was used in mass selection. It was done in various steps, viz. selection of desirable plants from base population, mixing their seed to raise next generation and initial evaluation in research station. An old variety Kathmandu Local was used as base population which was grown in a large plot at Horticilture Research Division, Khumaltar. Two hundred plants were selected on the basis of phenotypic performance for characters like earliness, size, colour and yield. The selected plants were used

for seed production and their seeds were mixed together to grow next generation. This process was repeated five years to select the genotype HRDCAU005.

***Genotype evaluation*:** The performance of the selected genotype (HRDCAU005) was evaluated at Horticulture Research Division, Khumaltar, Agriculture Research Station, Dailekh, Agriculture Research Station, Pakhribas and farmers fields in Nala Kavre, Kalbhairab Dailekh and Pakhribas. Onstation and onfarm trials were conducted for 2 years using Kathmandu Local and White Flash (hybrid) as standard checks for comparision. The experiments were arranged in randomize complete block design (RCBD) with five replications. Different genotypes of cauliflower were transplanted in 20-25 August 2012 and 2013 in the plot size of 5.4 m^2 with the spacing of 60 X 45 cm. The crop was fertilized by compost @ 1500 kg and NPK 17:14:12 kg/Ropani (508.74 m^2). Data regarding curd wt., days to first harvest, days to last harvest, leaf type, no of leaves per plant, yield, curd colour, compactness, taste, disease and insect attack were recorded. Curd colour was recorded on the basis of 1 to 5 scale, i.e. 1 = Brown with black spots; 2= Yellowish brown; 3= Yellowish white; 4= Creamy white; 5= Snow white. An evaluation panel on the basis of colour, size, compactness and taste measured consumers' acceptability by using 1-5 scale, in which 1 stands for inferiority and 5 for superiority. Based on cumulative records of all characters consumers' acceptability was determined.

Results and Discussion

Characteristics of selected genotype

After series of selection a genotype HRDCAU005 which matures 65-80 days after transplanting and have good marketable size (around 1 kg) with better taste was selected from the old cauliflower variety Kathmandu Local. Plant structure of this genotype is upright, curd colour is creamy white and leaves are non-serrated. Major identifying characteristics of this selected genotype are presented in Table 1.

Table 1. Major characteristics of HRDCAU005 at HRD, Khumaltar (2007-2011)

SN	Characters	Mean
1	Number of leaves per plant	22
2	Curd wt. (kg)	0.97
3	Yield (t/ha)	28.95
4	Curd colour	Creamy white
5	Days to first harvest (after transplanting)	65
6	Days to last harvest (after transplanting)	80
7	Leaf angle	Erect to semi-erect
8	Plant structure	Upright
9	Leaf colour	Light green
10	Leaf type	Non-serrated

Coordinated Varietal Trial (CVT) at HRD, Khumaltar, Lalitpur (2012 and 2013)

The curd yield of four evaluated genotypes/varieties of cauliflower at Horticulture Research Division, Khumaltar is presented in Table 2. The days to harvest of the genotypes were significantly different, where HRDCAU005 was 20 days earlier than Kathmandu Local. Genotype HRDCAU005 was ready to first harvest at 64 days and last harvest at 82 days after transplanting. The evaluated genotypes also differed significantly in yield. Kathmandu Local produced the highest curd yield (43.50 t/ha), whereas the lowest curd yield (21.00 t/ha) was recorded in White Flash. The average plant weight differences among the genotypes/varieties were statistically significant. Maximum plant weight (2.54 kg) was recorded in Kathmandu Local variety followed by HRDCAU005 (2.03 kg) and White Flash (1.29 kg) respectively. The selected genotype HRDCAU005 showed the best result with attractive colour, marketable size and better taste along with earliness.

Table 2. Performance of cauliflower genotypes at HRD Khumaltar (2012-2013)

Genotypes	Av. Plant wt (kg)	Individual Curd wt(kg)	Yield (t/ha)	Days to first harvest*	Days to last harvest*	Leaf type
Kathmandu Local	2.54	1.45	43.50	84	102.0	Spreading
HRDCAU005	2.03	1.01	30.30	64.25	82.0	Erect
HRDCAU003	1.19	0.80	24.00	50.25	68.0	Semi Erect
White Flash	1.29	0.70	21.00	55.00	73.0	Spreading
P-value	<001	0.008	-	<001	<001	-
$LSD_{(0.05)}$	0.54	0.402	-	4.43	4.43	-
CV%	17.4	25.5	-	3.3	3.3	-

Note: *Days after transplanting

Coordinated varietal trial (CVT) at Dailekh (2012 and 2013)

The detail results of cauliflower genotypes tested at ARS, Dailekh are presented in Table 3. The overall mean curd yield indicated that Kathmandu Local produced the highest curd yield (41.40 t/ha) followed by HRDCAU005 (31.50 t/ha) and the lowest (19.80 t/ha) in White Flash. Cauliflower genotype HRDCAU003 and White Flash variety were ready to first harvest at 65 days followed by HRDCAU005 at 80 days and Kathmandu Local by 90 days after transplanting.

Table 3. Performance of cauliflower genotypes at ARS Dailekh (2012-2013)

Genotypes	Av. Plant wt (kg)	Individual Curd wt(kg)	Yield (t/ha)	Days to first harvest*	Days to last harvest*	Leaf type
Kathmandu Local	2.52	1.38	41.40	90	110	Spreading
HRDCAU005	2.03	1.05	31.50	80	90	Erect
HRDCAU003	1.46	0.73	21.90	65	85	Semi Erect
White Flash	1.32	0.66	19.80	65	85	Spreading

Note: *Days after transplanting

Coordinated varietal trial (CVT) at Pakhribas (2012 and 2013)

The mean data of four evaluated genotypes/varieties are presented in Table 4. The Kathmandu Local variety was found highest yielder (36 t/ha) followed by White Flash and HRDCAU005 (Table 4). The mean data indicated that HRDCAU003 was ready to harvest at 56 days followed by White Flash at 69 days and HRDCAU005 at 75 days after transplanting.

Table 4. Performance of cauliflower genotypes tested at ARS Pakhribas (2012-2013)

Genotypes	Individual curd weight (kg)	Curd yield (t/ha)	Leaf number/plant	First harvest*	Last harvest*
Kathmandu Local	1.20	36.00	21.85	84.2	110.2
HRDCAU005	0.815	24.45	20.35	75.0	94.0
HRDCAU003	0.629	18.87	18.65	56.2	69.8
White Flash	1.03	30.90	20.95	69.0	80.0

Note: *Days after transplanting

Table 5. Performance of cauliflower genotypes tested at farmers field (2012-2013)

Characters	Genotypes	Farmers field Kavre	Farmers field Dailekh	Farmers field Pakhribas	Mean
No. of leaves at harvest	Kathmandu Local	19.4	24.1	21.20	21.56
	HRDCAU005	21.6	23.6	20.60	21.93
	White Flash	24.2	25.2	20.80	23.50
Individual curd weight (kg)	Kathmandu Local	1.4	1.6	1.19	1.39
	HRDCAU005	1.1	1.0	0.86	0.99
	White Flash	0.9	1.1	0.84	0.95
Curd yield (t/ha)	Kathmandu Local	42.0	48.0	35.70	41.90
	HRDCAU005	33.0	30.3	25.86	29.72
	White Flash	27.0	33.0	25.23	28.41
Days to first harvest	Kathmandu Local	75.0	90.0	82.00	82.33
	HRDCAU005	68.0	67.0	75.00	70.00
	White Flash	58.0	65.0	76.00	66.33
Days to last harvest	Kathmandu Local	110.0	115	105.00	110.00
	HRDCAU005	80.0	85.0	86.00	83.66
	White Flash	75.0	78.0	71.00	74.66
Leaf angle	Kathmandu Local	Spreading	Spreading	Spreading	Spreading
	HRDCAU005	Upright	Upright	Upright	Upright
	White Flash	Spreading	Spreading	Spreading	Spreading

Farmers field trial (FFT) at Kavre, Dailekh and Pakhribas (2012 and 2013)

The promising genotype HRDCAU005 was tested in farmers field during 2012 and 2013 in Nala, Kavre, Kalbhairab–1, Dailekh and Pakhribas. On an average, HRDCAU005 was ready to first harvest at 70 days after transplanting. Kathmandu Local produced the highest average curd yield of 41.9 t/ha. The productivity of HRDCAU005 was higher than White Flash at all sites. The highest curd yield of HRDCAU 005 was recorded at Nala, Kavre (33 t/ha) followed by Dailekh (30.30 t/ha) and Phakribas 25.86 t/ha (Table 5). Farmers from all the sites (Kavre, Dailekh and Pakhribas) preferred HRDCAU005 for its earliness, attractive colour, marketable size, cooking quality and better taste.

Consumer acceptability

Consumer acceptability was measured on the basis of organoleptic evaluation based on curd colour, compactness and taste. The genotype HRDCAU005 showed highest degree of acceptability. This superiority might be due to marketable size, colour and good taste (Fig.1).

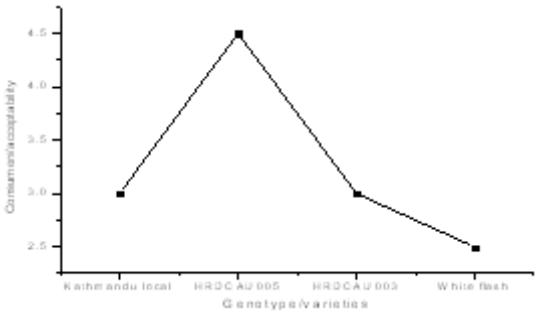

Fig.1. Consumers' acceptability of cauliflower curd

Disease and insect scoring

So far data received from different stations and farmers' field genotype HRDCAU005 was not suffered from severe attack of any disease and insect. However, downy mildew, alternaria black spot, diamond back moth, cabbage butterfly and aphids were recorded (Table 6 & 7). In both the years, maximum attack of diamond back moth was found in the hybrid variety White Flash one of the check variety where as the least diamond back moth attack was observed in the genotype HRDCAU005. It indicates that White Flash is susceptible to diamond back moth where as the selected genotype HRDCAU005 is tolerant.

Table 6 Disease scoring on the tested genotypes (1-9 scale) at Nala, Kavre

Genotypes	2012		2013	
	Downy mildew	Alternaria black spot	Downy mildew	Alternaria black spot
Kathmandu Local	2	2	1	2
HRDCAU005	2	2	1	2
HRDCAU003	3	4	2	3
White Flash	3	5	4	3

1= No disease, 9 = complete damage

Table 7 Insect scoring of the tested genotypes (1-9 scale) at Nala, Kavre

Genotypes	2012			2013		
	Diamond back moth	Cabbage butterfly	Aphids	Diamond back moth	Cabbage butterfly	Aphid
Kathmandu Local	2	1	3	1	1	3
HRDCAU005	1	1	3	1	2	3
HRDCAU003	3	2	4	4	5	4
White Flash	5	4	4	4	6	4

1= No insect, 9 = complete damage

Economic analysis

Cost of production was calculated by taking into consideration of the expenditure incurred on cost for the field preparation, nursery, transplanting, fertilizer application, weeding, pesticide application, material cost like seed, pesticides and fertilizers. Experiment was conducted in farmers' fields at Nala, Kavre to know about the economic performance of selected genotype. The net income Rs 19765 per Ropani was computed from HRDCAU005. Detail cost of cultivation and income has been presented in Table 8.

Table 8 Summary of cost of production (planting distance : 60X45 = 1500 plants/ Ropani)

SN	Title of expenditure	Number/Quantity	Amount of expenditure (NRs)
1	Land rent	1 Ropani X 3500	3500/-
2	Seed	15g	200/-
3	Pesticide/ Micronutrient	LS	500/-
4	Borax	1 kg X 200	200/-
5	Nursery cost	LS	1000/-
6	Compost	1500 X 2	3000/-
7	DAP	30 kg X 52	1560/-
8	MOP	15 kg X 45	675/-
9	Urea	30 kg X 40	1200/-
10	Land preparation	6 Labour X 400	2400/-
11	Planting	1 Labour X 400	400/-
12	Irrigation	6 Labour X 400	2400/-
13	Weeding & intercultural operation	6 Labour X 400	2400/-
14	Fertilizer application	4 Labour X 400	1600/-
15	Harvesting	400 X 3 Labour	1200/-
16	Marketing cost	LS	3000/-
	Total cost of production	-	**25235**
➢	Selling price per kg (Rs): 30		
➢	Income from Fresh curd: Rs 45000 per Ropani		
➢	Cost of production: Rs. 25235 per Ropani		
➢	Net Income: Rs. 19,765 per Ropani		

Recommended domain

Mid hills regions, where the elevation ranges 800 to 1500 masl are mainly suitable to grow the Cauliflower genotype HRDCAU005. When other conditions are favourable, this genotype can be grown on any good soil, but a fairly deep loamy soil is most desirable. It is sensitive to high acidity. The optimum soil pH for maximum production is 5.5 – 6.5. August-September planting requires frequent irrigation, to get better yield water logging should be avoided. Temperature plays an important role influencing vegetative, curding and reproductive phases of plants. The optimum temperature for young seedlings around 23^0C which at later growing stage drops to 17^0C to 20^0C. However, if the temperature remains high (than required for curding), the plant will remain vegetative without forming any curd and continues to form new foliage. It has also been identified that between 15^0C and 20^0C the growth would be normal for this genotype. The growth and development of this cauliflower is classified in three stages like vegetative phase, curd initiation phase and curd development phase. The plant development takes place in the vegetative phase; hence water and fertility in the soil should be optimum along with the appropriate temperature. The temperature should not fluctuate too much during the curd initiation phase otherwise the curd quality will deteriorate.

The areas under farmers field trials were dominated for cultivation of different vegetables like potato, tomato, cauliflower, cabbage, onion and garlic. With the development of new and early maturing cauliflower variety which is transplanted in August and harvested by October-November, Tomato-cauliflower-garden pea cropping system is emerged as a most beneficial cropping system particularly for mid hills. Similarly, maize based cropping system (maize-cauliflower-onion) is also possible in mid hills of Nepal. So, this genotype is recommended to release as a variety and needs to be promoted for income generation.

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