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Economics analysis of cabbage (*Brassica oleracea* var. *Capitata* L.) Under different level of fertigation with and without mulch

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Abstract
A field experiment was conducted in the experimental farm of the department of horticulture, Assam Agricultural University, Jorhat during 2011- 2012 in the winter season to evaluate the economic feasibility of cabbage. The experiment was laid out in randomized block design. The experiment conducted had 3 irrigation levels, 3 Fertigation levels and levels of mulch. The benefit cost ratio was found to be the highest gross return and net return was obtained by 100% OPE, 100%RD of N&K with mulch (Rs. 1043920), (856567.6) and B: C ratios were (4.57).

Keywords: cabbage, fertigation, mulch, economics

Introduction
Although India has the largest irrigation network in the world; its irrigation efficiency has not been more than 40 per cent. Bringing more area under irrigation will largely depend upon efficient use of water. In this context, micro irrigation has most significant role to achieve not only higher productivity and water use efficiency but also to have sustainability with economic use and productivity. Fertigation is the process wherein fertilizer is applied through an efficient irrigation system like drip. In fertigation, nutrient use efficiency could be as high as 90 per cent compared to 40 to 60 per cent in conventional methods (Solaimalai *et al.*, 2005) [1]. Drip irrigation has proved its superiority over other methods owing to direct application of water in the root zone. Indiscriminate use of water through conventional irrigation system with only 60 per cent application efficiency is causing serious threat to available ground water resources. Drip irrigation can play a vital role in maximizing water use efficiency. Low nitrogen use efficiency in conventional method of irrigation is also a major reason for low productivity of crops. Drip irrigation is at present economically feasible in high value crops. Mulching is used to cover soil surface around the plants to create congenial condition for the plant growth. Polythylene mulches are widely used in the cultivation of vegetables. Weed control, temperature moderation, salinity reduction etc. are the desirable effects of plastic mulching It also exerts decisive effects on earliness, yield and quality of the crop (*Raina et al*.,1999) [2]; (Bharadwaj, 2013) [3]

The present investigation was carried out to evaluate economics analysis of cabbage (*Brassica oleracea* var. *Capitata* L.) Under different level of fertigation with and with out mulch black film mulch. The experiment was carried out in the Experimental Farm, Department of Horticulture, Assam Agricultural University, Jorhat during 2012. Eighteen treatments were allocated in a randomized block design with three replications. The treatment comprised of three levels of irrigation *viz*., 100% OPE (D_1), 75% OPE (D_2), 50% OPE (D_3) based on previous ten years open pan evaporation data and three levels of fertigation *viz*., 100% RD of N and K (F_1), 75% RD of N and K (F_2) and 50% RD of N and K (F_3) based on recommended doses @ 120:60: 60, P was applied as basal dose with mulch (M_1) and without mulch (M_2). Cabbage variety selected in the present study was Green Express. Green Express is a F_1 hybrid. It is a popular early variety, ready to harvest 55 to 60 days after transplanting. The seedlings were transplanted at a spacing of 60 cm x 45 cm. Gap filling was done seven days after transplanting.

Treatment combinations
Treatments and treatment combination used in the experiment are as follow:

Notation	Treatments	Notation	Treatments
T1 (D1F1M1)	100% OPE, 100% RD of N&K with mulch	T_{10} ($D_1F_1M_0$)	100% OPE, 100% RD of N&K without mulch
T2 (D1F2M1)	100% OPE, 75% RD of N&K with mulch	T_{11} ($D_1F_2M_0$)	100% OPE, 75% RD of N&K without mulch
T_3 ($D_1F_3M_1$)	100% OPE, 50% RD of N&K with mulch	T_{12} ($D_1F_3M_0$)	100% OPE, 50% RD of N&K without mulch
T_4 ($D_2F_1M_1$)	75% OPE, 100% RD of N&K with mulch	T_{13} ($D_2F_1M_0$)	75% OPE, 100% RD of N&K without mulch
T_5 ($D_2F_2M_1$)	75% OPE, 75% RD of N&K with mulch	T_{14} ($D_2F_2M_0$)	75% OPE, 75% RD of N&K without mulch
T6 (D2F3M1)	75% OPE, 50% RD of N&K with mulch	T_{15} ($D_2F_3M_0$)	75% OPE, 50% N&K without mulch
T7 (D3F1M1)	50% OPE, 100% RD of N&K with mulch	T_{16} ($D_3F_1M_0$)	50% OPE, 100% RD of N&K without mulch
T_8 ($D_3F_2M_1$)	50% OPE, 75% RD of N&K with mulch	T_{17} ($D_3F_2M_0$)	50% OPE, 75% RD of N&K without mulch
T_9 ($D_3F_3M_1$)	50% OPE, 50% RD of N&K with mulch	T_{18} ($D_3F_3M_0$)	50% OPE, 50% RD of N&K without mulch

The different treatments showed the water impact on the comparative economics of the activation of cabbage. The highest benefit to cost ratio under the treatment T_1 (100% OPE, 100% RD of and N and K under mulch may be due to higher yield even though the cost increased under this treatment was more than unmulch ones. Maximum net profit of Rs 856567.6/ha with B:C ratio of 4.57 was recorded in treatment black plastic mulch and minimum net profit of Rs 346476.5/ha with a B:C ratio of 2.00 without mulch was recorded in (Table 1). The results are in conformity with the findings of Singh (2007) [4]; Brahma *et al* (2010) [5] and Baruah (1993) [6].

From the forgoing discussion it is clearly indicated that the drip irrigation particularly higher level of OPE replenishment with fertigation of 100% RD of N and K under mulch had produced profound beneficial influenced over the vegetative growth, yield and yield attributing characters of cabbage and yield. Considering the yield and economics of cultivation, drip fertigation at 100% OPE with 100% RD of N and K with mulch can be considered as best treatment for cabbage under prevailing weather condition.

From the discussion, it is also clear that mulching is beneficial on cabbage. Mulching is found to be superior in respect of growth and yield than unmulch plots. Hence, mulching and drip irrigation at 100% OPE along with fertigation at 100% RD of N and K can be considered as best treatment for cabbage.

Table 1: Benefit cost ratio

Item	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
1.Fixed cost (Rs)									
System cost	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75
a) Annualized cost	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87
b) Interest on investment @ 12%	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85
Total fixed cost (a+ b)	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72
2. Variable cost (Rs)									
a) Maintenance cost @ 2%	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97
b) Operational cost.	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28
c) Treatment cost	23675.45	22776.79	21877.51	23643.6	22744.94	21845.66	23604.47	22705.81	21806.53
3. Total variable cost (a+ b+ c)	164989.7	164091	163191.8	164957.9	164059.2	163159.9	164918.7	164020.1	163120.8
4. Seasonal total cost (Rs/ha) (1+2)	187352.4	186453.8	185554.5	187320.6	186421.9	185522.6	187281.4	186382.8	185483.5
5. Yield (t/ha)	130.49	117.50	104.33	97.93	96.85	91.40	79.04	78.13	71.87
6. Income from produce: (Rs) Yield @ Rs 8/ kg	1043920	940000	834640	783440	774800	731200	632320	625040	574960
7. Net income (6-4) (Rs)	856567.6	753546.2	649085.5	596119.4	588378.1	545677.4	445038.6	438657.2	389476.5
8. Benefit cost ratio	4.57	4.04	3.49	3.18	3.15	2.94	2.31	2.35	2.09

Contd/-

Item	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}	T_{15}	T_{16}	T_{17}	T_{18}
1.Fixed cost (Rs)									
System cost	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75	101648.75
a) Annualized cost	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87	10164.87
b) Interest on investment @ 12%	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85	12197.85
Total fixed cost (a+b)	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72	22362.72
2. Variable cost (Rs)									
a) Maintenance cost @ 2%	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97	2032.97
b) Operational cost.	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28	139281.28
c) Treatment cost	10675.45	9776.79	8877.51	10643.6	9744.99	8845.66	10604.47	9705.81	8806.53
3. Total variable cost (a+ b+ c)	151989.7	151091.0	151091.8	151957.9	151059.2	150159.9	151918.7	151020.1	150120.8
4. Seasonal total cost (Rs/ha) (1+2)	174352.4	173453.8	172554.5	174320.6	173422	172522.6	174281.4	173382.8	172483.5
5. Yield (t/ha)	96.76	87.67	81.80	77.67	77.47	77.47	69.20	67.50	64.87
6. Income from produce: (Rs) Yield @ Rs 8/ kg	774080	701360	654400	621360	619760	619760	553600	540000	518960
7. Net income (6-4) (Rs)	599727.6	527906.2	481845.5	447039.4	446338	447237.4	379318.6	366617.2	346476.5
8. Benefit cost ratio	3.43	3.04	2.79	2.56	2.57	2.59	2.17	2.11	2.00

Sale price: @ Rs. 8/- per kg

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