Original Research Article

EFFECT OF SOWING DATE ON ECONOMIC RETURN AND BIOCHEMICAL TRAITS OF BROCCOLI (*BRASSICA OLERACEA* VAR. *ITALICA*.PLENCK)

ABSTRACT

A field experiment was conducted during the *Rabi* season of 2016 to 2017 at Vegetable Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.) to find out the optimum time of sowing and plant spacing for broccoli variety Palam Samridhi, Pusa Kanchan and Lufa F_1 Hybrid. Seedlings were raised by sowing on three different dates viz. 20th October, 04 November and 19 November were transplanted at spacing viz. 45 cm x 45 cm. Economic return and biochemical traits were significantly influenced by the treatments. The results regarding that, effect of date of sowing and different varieties on economic return and Biochemical traits of broccoli. In view of experimental results obtained during the present investigation, treatment T_4 D_2 V_1 04 November + V_1 Palam Samridhi emerged as superior over all other treatments, in relation to economic return, cost benefit ratio and biochemical traits of Broccoli under the agro-climatic condition of Allahabad.

Key words: Broccoli, Agro-climatic condition, Economic return, Biochemical traits.

---

1. INTRODUCTION

Broccoli is a cool season crop. It is more sensitive when the plants are small and tender. They are susceptible to cold injury. Warm weather is disadvantageous, since the bud cluster loose quickly. In Northern India, it is generally in the month of September and October and is ready for harvest from the November to early December and may continue till early February. The nutritive value of Broccoli per 100 g of edible portion is given below (**Brown and Hutchison, 1949), [2].** Water -89.3%, Protein -3.6%, Fats - 0.2 %, Carbohydrates - 5.5%, Fiber- 1.2 g, Vitamin A- 900 (I.U.) mg, Vitamin B (combined) - 33 (I.U.) mg, Vitamin C - 137 (I.U.) mg, Vitamin E- 2.3(I.U.) mg,Vitamin K- 3.5 (I.U) mg, Calcium -1.29 mg, Manganese - 20 mg, Iron - 1.3 mg, Phosphorus- 0.79 mg, Sulphur-1.26 mg, Chlorine- 40 .0 mg. Broccoli has lots of medicinal importance. The national research council committee on diet, nutrition and cancer has recommended increased consumption of broccoli to decrease the incidence of cancer. *Brassica* vegetables contain high concentrations of carotenoids, which are believed to be chemo preventive and associated with a decreased risk for various human cancers in epidemiological studies. . It has about 130 times more vitamin A content than cauliflower and 22 times more than cabbage. It contains Sulforaphane, which block growth of tumour and reduce the risk of cancer. It also contains a few important phyto-chemicals, beta-carotene, indoles and isothiocyanates. The excessive use of chemical fertilizers has caused tremendous harm to environment Although the use of chemical fertilizers have

Comment [AS1]: Planting dates

Comment [AS2]: Small

Comment [AS3]: 2016-17

Comment [AS4]: planting

Comment [AS5]: varities as

Comment [AS6]: planting

Comment [AS7]: Traits of broccoli

Comment [AS8]: Revealed that Palam Samridhi (V_1) variety planted on 4 November

Comment [AS9]: Delete

Comment [AS10]: Small

Comment [AS11]: varities

Comment [AS12]: Planting dates

Comment [AS13]: Is also

Comment [AS14]: Delete

Comment [AS15]: Small

Comment [AS16]: Delete

Comment [AS17]: as

Comment [AS18]: Small letter of word of all parameters of quality

Comment [AS19]: Small

Comment [AS20]: Comma after this

Comment [AS21]: Author given the little importance of chemical fertilizer that is not treatment but not given the importance of improved varieties and planting time. Also not given the earlier status of planting of broccoli in the study areas. Importance was not given by the work of the previous studies conducted with references.

become essential part of production and a balanced form of fertilizer use is always a pre-requisite to higher yield. However, these chemical fertilizers are costlier and also pollute the environment through the process of de-nitrification and volatilization and soil water through leaching. Only 50% of available nitrogen being used and rest 50% goes as waste, which is an environmental hazard.

Comment [AS22]: Need to improve the end of the introduction by keeping the above

2. MATERIALS AND METHODS

The details of various materials used and the methods employed in carrying out the experiment are described in detail under appropriate heading.

2.1 Experimental site

The experiment was conducted at Vegetable Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad. during the (*Rabi*) season of 2016-2017. All the facilities necessary for conducting the experiment, including labour and resources, which were necessary for normal cultivation were readily available in the department.

Comment [AS23]: Delete

Comment [AS24]: 2016-17

Comment [AS25]: Delete

Comment [AS26]: Provided by

2.2 Climatic condition

The area of Allahabad district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 32^{0}C – 34^{0}C and seldom falls as low as 4^{0}C – 5^{0}C. The relative humidity ranged between 20 to 94 per cent. The average rainfalls in this area is around 1013.4 mm annually. The meteorological data (Oct, 2012 to March, 2013) with respective to total rainfall, maximum and minimum temperature, relative humidity are presented in table-1.

Comment [AS27]: Delete

Comment [AS28]: Delete

Comment [AS29]: Delete

Comment [AS30]: Study conducted in 2016-17

Table-1: Meteorological data (October 2016 –January 2017)

Weeks	Temperature^{0}C		Rainfall (mm)	Relative humidity (%)	
	Maximum	Minimum		Maximum	Minimum
October 2016					
1st Week	36.00	26.00	0	87	51
2nd week	35.20	26.00	0	90	52
3rd week	35.20	25.40	0	90	53
4th week	34.00	23.00	0	90	55
November 2016					
1st Week	33.80	18.40	0	91	54
2nd week	32.40	16.20	0	93	58
3rd week	31.80	15.80	0	92	50
4th week	31.00	15.00	0	92	45
December 2016					
1st Week	23.40	14.00	0	93	81
2nd week	26.00	12.00	0	94	58
3rd week	25.80	11.80	0	92	46
4th week	24.00	9.20	0	91	53

January 2017					
1st Week	22.40	11.00	0	91	46
2nd week	23.40	6.80	0	91	50
3rd week	25.40	11.40	0	91	44
4th week	29.00	12.00	0	90	41

Source: Agro-meteorological Observatory Unit, School of Forestry & Environment, Sam Higginbottom University of Agriculture, Technology and Sciences, (Deemed to be University), Allahabad.

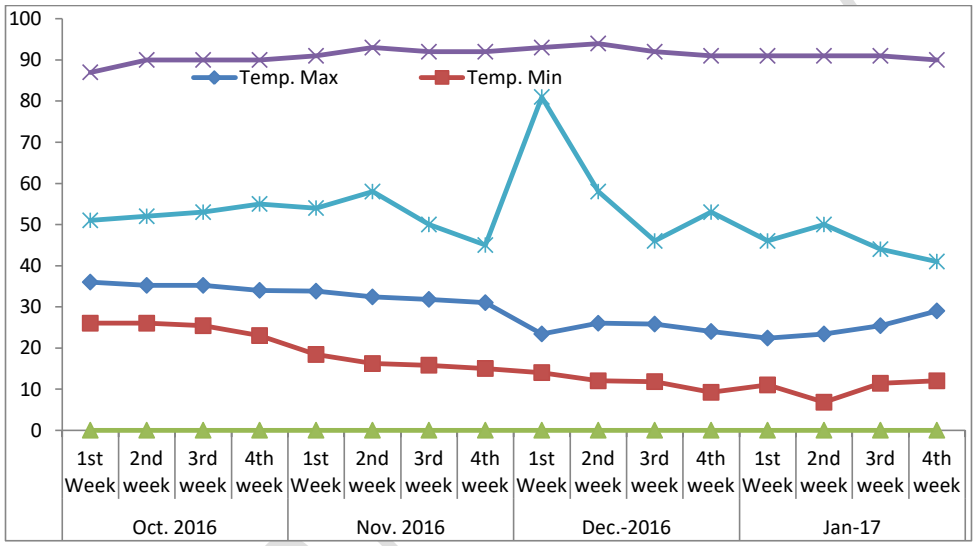

Fig.1 Meteorological data (October 2016 – January 2017).

2.3 Soil characteristics of the experimental site

The experimental site is fairly level land with sandy loam soil of uniform fertility status with low clay and high sand percentage. soil sample were collected at random spots from depth of 0-30 cm and the soil was analyzed for pH, electrical conductivity (EC), organic carbon, available nitrogen, available phosphorus and available potassium are presented in table-2.

2.4 Field preparation

Experimental plot was prepared one month before transplanting. The soil was ploughed manually, levelled and the weeds were rooted out. The experimental area was laid out in raised bed with 1m cm width and 30 cm height. Well decomposed farm yard manure was applied one week before transplanting at the rate of 15 t/ha.

Table-2 Physical and chemical properties of soil at experimental site (SHUATS).

Sl. No.	Particulars	Value(0-30cm depth)	Methods employed
Physical properties			
1	Sand	60.60%	Hydrometer Method **(Bouyoucos, 1952)**
2	Silt	19.10%	
3	Clay	20.30%	
4	Textural class	Sandy loam	
Chemical properties			
1	Soil pH	6.5	Digital pH meter Mk. IV
2	EC	0.26 (dSm^{-1} at 25^0 C)	Electrical Conductivity Meter
3	Organic carbon	0.45 %	Hydrochloric oxidation Method **(Walkely and Black,1934)**
4	Available nitrogen	212.56 kg ha^{-1}	Alkaline permanganate method **(Subbaiah and Asija, 1956)**
5	Available phosphorus	37.32 kg ha^{-1}	Olsen's Colorimetric method **(Olsen *et al*., 1954)**
6	Available potassium	210.05 kg ha^{-1}	Flame photometric method **(Jackson, 1958)**

2.5 Layout and Design of the Experiments

Comment [AS31]: Small

Comment [AS32]: Delete

The experiment was laid in Factorial Randomized Block Design with 3x3 treatments, each replicated three times, thus making a total of 27 plots. The unit plot size was 1.8 x 1.5 m^2. The plants were spaced at 45cm between the rows and 45 cm between the plants. There were total of 9 plants in each plot. The treatments were allocated randomly to a unit plot in each replication.

Table-3 Treatment Combination

Treatment No.	Treatment Symbol	Treatment combination
T_1	D_1V_1	20 October + V_1 Palam Samridhi
T_2	D_1V_2	20 October + V_2 Pusa Kanchan
T_3	D_1V_3	20 October + V_3 Lufa F_1 Hybrid
T_4	D_2V_1	04 November + V_1 Palam Samridhi
T_5	D_2V_2	04 November + V_2 Pusa Kanchan
T_6	D_2V_3	04 November + V_3 Lufa F_1 Hybrid
T_7	D_3V_1	19 November + V_1 Palam Samridhi
T_8	D_3V_2	19 November + V_2 Pusa Kanchan
T_9	D_3V_3	19 November + V_3 Lufa F_1 Hybrid

2.6 Nutrient application

Recommended dose of fertilizer, 120:60:60 kg of NPK per hectare was applied as basal dose. Sources of nitrogen, phosphorus and potassium were Urea (46% nitrogen), single Super phosphate (16%) and Muriate of Potash (60% potassium). Half dose of nitrogen, total phosphorus and potash were well mixed and applied as basal dose before transplanting, according to the treatment. Balance half quantity of nitrogen was applied as top dressing at 30 days after transplanting.

2.7 Transplanting of Seedlings

Broccoli plant was transplanted in the main field on 22th November 2012. Thirty days old healthy seedling having two pairs of leaves with a height of 10 to 15 cms were selected from the nursery and roots of the plant were treated first with Azospirillum according to treatment before transplanting and transplanted at the experimental plot and given light irrigation.

3. OBSERVATIONS TO BE RECORDED

Observations were recorded on three randomly selected plants of each treatment to assess the effect of treatments on yield, economic return and Bio-chemical traits of broccoli in the following characters.

3.1**Curd yield (t ha^{-1})**

Curd yield of the crop was calculated immediately after removing the heads from the plant from each plot. Thus the total yield in quintals per hectare was worked out and statistically analysed.

3.2 Biochemical Traits

After harvesting of matured curds, in order to assess the quality of the curds, tests were carried out at the Laboratory of the Department of Horticulture, to find out the following**:**

3.3 Ascorbic acid (mg/100g of edible portion)

Weigh 100mg of ascorbic acid on a chemical balance and dissolve in 3 per cent metaphosphoric acid, make the volume upto 500 ml.

3.4 Total soluble solid (%)

Total soluble solid was determined with the help of Erma hand refracto meter (0.32 range) average and analyzed.

4. ECONOMICS OF CULTIVATION

As per the existing market prices, the input and output costs were computed treatment- wise and different economic parameters *viz.*, cost of cultivation, gross return, net return and cost- benefit ratio were calculated.

4.1 Cost of cultivation (t ha^{-1})

The cost of the inputs that was prevailing at the time of their use was considered (Appendix) to work out the cost of cultivation which is given in rupees per hectare.

Comment [AS33]: as

Comment [AS34]: Small

Comment [AS35]: Small

Comment [AS36]: Small

Comment [AS37]: Small

Comment [AS38]: Small

Comment [AS39]: Trial conducted in 2016-17 and author mentioning in 2012 at many palces it shows data first use in 2012-13 now publishing in 2016-17

Comment [AS40]: Italic

Comment [AS41]: Observations to be recorded

Comment [AS42]: Small

Comment [AS43]: Economics of cultivation

Comment [AS44]: ?

Comment [AS45]: Comma after this

4.2 Gross income

Gross income was calculated based on the prevailing market price for the produce.

4.3 Net income

The net income per hectare was calculated on the basis of gross income and cost of cultivation per hectare as follows-

Net income = Gross income - Cost of cultivation

4.4 Benefit to Cost ratio

The benefit to cost ratio was worked out by using the following formula.

$$\text{Benefit: Cost ratio} = \frac{\text{Gross income (Rsha}^{-1})}{\text{Cost of cultivation (Rs/ha)}}$$

All the recorded observations were subjected to the statistical analysis methods **(Panse, G and Sukhatme, P.V. 1985), [11].**The significance and non- significance of the treatment effect was judged with the help of 'F' variance ratio test. Calculated 'F' value was compared with the table value of 'F' at 5% level of significance. If the calculated value exceeded the table value, the effect was considered to be significant. The significant differences between the means were tested against the critical differences at 5% level of significance.

5. RESULTS AND DISCUSSION

5.1 Curd yield (t ha^{-1})

The results of the investigation, regarding the effect of dates of sowing and different varieties on yield, economic return and Bio-chemical traits of broccoli have been presented in tables and bar-diagrams .Results of the experiment are summarized below. The Curd yield (t ha^{-1}) as influenced by different treatments at presented in Table-4. The Curd yield (t ha^{-1}) was found to be significant among the treatments. The maximum Curd yield (t ha^{-1}) (14.07) was observed in D2- 4 Nov followed by the treatment D_1-20 Oct and Minimum Curd yield (t ha^{-1}) (13.08) was found to be in D_3-19 Nov. The Curd yield (t ha^{-1}) was found to be significant among the treatments. The maximum Curd yield (t ha^{-1}) (14.29) was observed in Palam Samridhi followed by Pusa Kanchan and minimum Curd yield (t ha^{-1}) (12.85) was found to be in Lufa F_1. As far as interaction between date of sowing and different varieties is concerned; the maximum Curd yield (t ha^{-1}) (16.25) was obtained with treatment T_4 D_2V_1 04 November + V_1 Palam Samridhi followed by treatments T_7 $D_3V_1$19 November + V_1 Palam Samridhi and the minimum Curd yield (t ha^{-1}) (12.24) remained with treatment T_9 $D_3V_3$19 November + V_3 Lufa F_1 Hybrid. The findings are in agreement with the result of [1], [10], [7] and [9].

Table-4 Effect of sowing of dates and different varieties on Curd yield (t ha^{-1}) of Broccoli.

Varieties	Curd yield (t ha^{-1})			
	Palam	Pusa	Lufa F-1	Mean
Date of sowing	Samridhi	Kanchan		

Comment [AS46]: Small

Comment [AS47]: Delete

Comment [AS48]: Delete

Comment [AS49]: Delete

Comment [AS50]: It

Comment [AS51]: Small

Comment [AS52]: Of 14.07 t ha^{-1}

Comment [AS53]: Use symbol or full date

Comment [AS54]: ?

Comment [AS55]: Small

Comment [AS56]: Small

Comment [AS57]: Of 13.08 t ha^{-1}

Comment [AS58]: Repetition

Comment [AS59]: Highest curd yield of 14.29 t ha^{-1} obtained from variety

Comment [AS60]: Lowest curd yield 12.85 t ha^{-} 1from

Comment [AS61]: From Palam Samridhi when planted on 4 November

Comment [AS62]: The same variety when planted on 19 November

Comment [AS63]: Was recorded from Lufa F_1 hybrid when planted on 19 November

Comment [AS64]: Planting

Comment [AS65]:

Comment [AS66]: Delete

Comment [AS67]: Small

Comment [AS68]: Sowing or planting

D1-20 Oct	15.22	12.43	13.27	**13.64**
D2- 4 Nov.	16.25	12.92	13.04	**14.07**
D3-19 Nov.	14.20	12.80	12.24	**13.08**
Mean	**14.29**	**13.65**	**12.85**	
	S.Ed.	**C.D.**	**F-test**	
Due to Date of sowing	0.023	0.048	S	
Due to varieties	0.023	0.048	S	
Due to date of sowing x varieties	0.039	0.084	S	

5.2 Total soluble solids (^{0}Brix)

The Total soluble solids (^{0}Brix) as influenced by different treatments at presented in Table 4.and Fig. 1.The Total soluble solids (^{0}Brix) was found to be significant among the treatments. The maximum Total soluble solids (^{0}Brix) (3.96) was observed in D2- 4 Nov followed by the treatment D3-19 Nov. and Minimum Total soluble solids (^{0}Brix) (3.59) was found to be in D_1-20 Oct. The Total soluble solids (^{0}Brix) was found to be significant among the treatments. The maximum Total soluble solids (^{0}Brix) (4.30) was observed in Palam Samridhi followed by Pusa Kanchan and minimum Total soluble solids (^{0}3.36) was found to be in Lufa F_1. As far as interaction between date of sowing and different varieties is concerned; the maximum Total soluble solids (^{0}Brix) (5.17) was obtained with treatment T_4 D_2V_1 04 November + V_1 Palam Samridhi followed by treatments T_7 $D_3V_1$19 November + V_1 Palam Samridhi and the minimum Total soluble solids (^{0}Brix) (3.15) remained with treatment T_9 $D_3V_3$19 November + V_3 Lufa F_1 Hybrid. The findings are in agreement with the result of [4], [6] and [5].

Table-5 Effect of sowing of dates and different varieties on TSS (^{0}Brix) of Broccoli.

Varieties	**Total soluble solids (^{0}Brix)**			
Date of sowing	**Palam Samridhi**	**Pusa Kanchan**	**Lufa F-1**	**Mean**
D1-20 Oct	4.07	3.18	3.53	**3.59**
D2- 4 Nov.	5.17	3.30	3.40	**3.96**
D3-19 Nov.	4.55	3.27	3.15	**3.66**
	4.30	**5.34**	**3.36**	
	S.Ed.	**C.D.**	**F-test**	
Due to Date of sowing	0.026	0.055	S	
Due to varieties	0.026	0.055	S	
Due to date of sowing x varieties	0.044	0.095	S	

5.3 Ascorbic acid (mg/100g)

Comment [AS69]: Delete

Comment [AS70]: V

Comment [AS71]: D

Comment [AS72]: Delete

Comment [AS73]: were

Comment [AS74]: The

Comment [AS75]: Was found to be significant

Comment [AS76]: Are corroborated with the results

Comment [AS77]: Small

Comment [AS78]: Delete

Comment [AS79]: V

Comment [AS80]: D

The Ascorbic acid (mg/100 g edible portion) as influenced by different treatments at presented in Table 4. and Fig. 2.The Ascorbic acid (mg/100 g edible portion) was found to be significant among the treatments. The maximum Ascorbic acid (mg/100 g edible portion) (113.04) was observed in D2- 4 Nov followed by the treatment D1-20 Oct and Minimum Ascorbic acid (mg/100 g edible portion) (110.82) was found to be in D3-19 Nov. The Ascorbic acid (mg/100 g edible portion) was found to be significant among the treatments. The maximum Ascorbic acid (mg/100 g edible portion) (113.98) was observed in Palam Samridhi followed by Pusa Kanchan and minimum Ascorbic acid (mg/100 g edible portion) (110.49) was found to be in Lufa F_1. As far as interaction between date of sowing and different varieties is concerned; the maximum Ascorbic acid (mg/100 g edible portion) (117.97) was obtained with treatment T_4 D_2V_1 04 November + V_1 Palam Samridhi followed by treatments T_7 $D_3V_1$19 November + V_1 Palam Samridhi and the minimum Ascorbic acid (mg/100 g edible portion) (107.56) remained with treatment T_9 $D_3V_3$19 November + V_3 Lufa F_1 Hybrid. The findings are in agreement with the result of [6], [4] and [3].

Table-6 Effect of sowing of dates and different varieties on Ascorbic acid (mg/100 g) of Broccoli.

Varieties	**Ascorbic acid (mg/100 g edible portion)**			
	Palam	**Pusa**	**Lufa F-1**	**Mean**
Date of sowing	**Samridhi**	**Kanchan**		
D1-20 Oct	110.33	109.63	108.67	**112.64**
D2- 4 Nov.	117.97	116.90	113.57	**113.04**
D3-19 Nov.	115.32	109.60	107.56	**110.82**
Mean	**113.98**	**112.04**	**110.49**	
	S.Ed.	**C.D.**	**F-test**	
Due to Date of sowing	0.192	0.410	S	
Due to varieties	0.192	0.410	S	
Due to date of sowing x varieties	0.332	0.711	S	

5.4 Economic Returns

The Economic returns as influenced by different treatments at presented in Table-7 and Fig.2.The Economic returns was found to be significant among the treatments. The maximum curd yield t/h (16.25) was observed in D_2- 4 Nov followed by the treatment D_1-20 Oct and Minimum yield t/h (12.24) was found to be in D_3-19 Nov. These findings are in agreement with the findings of [10], [1] and [7].The Gross returns were found to be significant among the treatments. The maximum gross returns Rs./h (26,0000) was observed in D_2- 4 Nov followed by the treatment D_1-20 Oct and Minimum gross return Rs./h (195,840) was found to be in D_3-19 Nov. These findings are in agreement with the findings of [8], [15] and [14]. The Economic returns were found to be significant among the treatments. The maximum net returns Rs./h (295,860) was observed in D_2- 4 Nov followed by the treatment D_1-20 Oct and Minimum net return Rs./h (131,700) was found to be in D_3-19 Nov. These

Comment [AS81]: Small
Comment [AS82]: Avoid Repetition
Comment [AS83]: Small
Comment [AS84]: Delete
Comment [AS85]: Delete
Comment [AS86]: Delet
Comment [AS87]: Small
Comment [AS88]: Small
Comment [AS89]: Rs. 260000/ha

findings are in agreement with the findings of [17] and [16]. The Economic returns were found to be significant among the treatments. The maximum benefit cost ratio (1:4.05) was observed in D_2- 4 Nov followed by the treatment D_1-20 Oct and Minimum benefit cost ratio (1:3.05) was found to be in D_3-19 Nov. These findings are in agreement with the findings of [12] and [13].

Table-7 Effect of sowing of dates and different varieties on economic returns of Broccoli.

Comment [AS90]: Small

Comment [AS91]: Small

Table -7	Economics of different treatments and benefit cost ratio for Broccoli.						
S. No	**Treatment Combination**	**Cost of cultivation (Rs. ha^{-1})**	**Curd yield (t ha^{-1})**	**Selling rate (Rs. t^{-1})**	**Gross return (Rs. ha^{-1})**	**Net return (Rs. ha^{-1})**	**Benefit cost ratio**
T_1	20 October + V_1 Palam Samridhi	64,140	15.22	16,000	243520	179380	1:3.80
T_2	20 October + V_2 Pusa Kanchan	64,140	12.43	16,000	198880	134740	1:3.10
T_3	20 October + V_3 Lufa F_1 Hybrid	64,140	13.27	16,000	212320	148180	1:3.31
T_4	04 November + V_1 Palam Samridhi	64,140	16.25	16,000	260000	195860	1:4.05
T_5	04 November + V_2 Pusa Kanchan	64,140	12.92	16,000	206720	142580	1:3.22
T_6	04 November + V_3 Lufa F_1 Hybrid	64,140	13.04	16,000	208640	144500	1:3.25
T_7	19 November + V_1 Palam Samridhi	64,140	14.20	16,000	227200	163060	1:3.54
T_8	19 November + V_2 Pusa Kanchan	64,140	12.80	16,000	204800	140660	1:3.19
T_9	19 November + V_3 Lufa F_1 Hybrid	64,140	12.24	16,000	195840	131700	1:3.05

Comment [AS92]: Use symbol here

Below give the detail

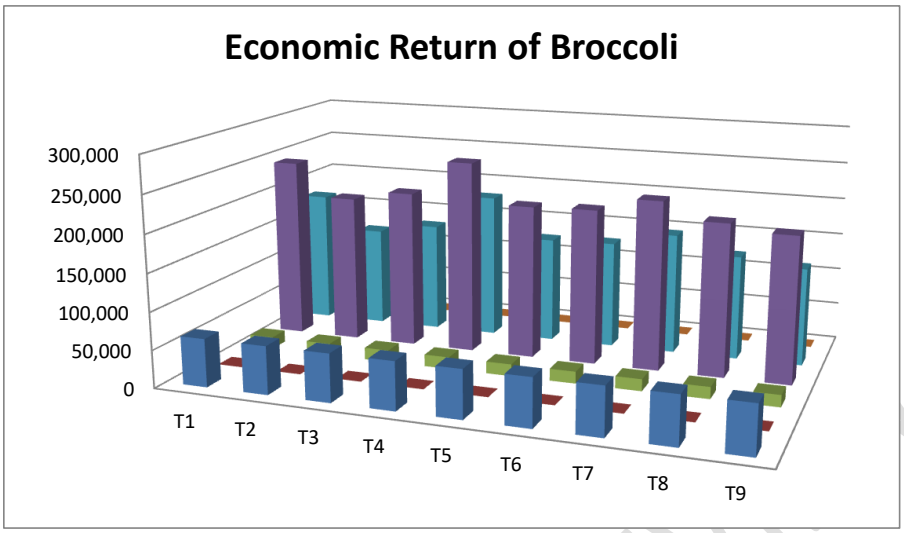

Fig.-2 Effect of sowing of dates and different varieties on economic returns of Broccoli.

6. CONCLUSION

It may be concluded from the experimental results obtained during the present investigation, treatment $T_4D_2V_1$ 04 November + V_1 Palam Samridhi emerged as superior over all other treatments, in relation to yield, Bio-chemical traits, economic return and cost benefit ratio 1:4.05 of Broccoli under the agro- climatic condition of Allahabad However, as compared to all other treatments with lowest yield recorded in control**,** since this is based on one – season experiment.

Comment [AS93]: , the

Comment [AS94]: Small

Comment [AS95]: Small

Comment [AS96]: Not clear

7. REFERENCES

1 Ahmed, M. Jamil and Siddique, W. Effect of sowing of dates on growth and yield of Broccoli (*Brassica oleracea* L.). Asian Journal of Plant Science.2004; 3 (2): 167-169.

2 Brown, H.D and Hutchison. C.S. Vegetables Science, J.B.Lippineot Company. New York. 1949: 21-30.

3 Cebula, C, Kunicki, E and Libik, A. The effect of cultivar and planting date on the yield and quality of white Cabbage grown in submontane region. Acta. Horticulture.1996;. 407.

4 Chatterjee, R. Effect of transplanting dates and spacing on seed yield and quality of cauliflower (Brassica oleracea var. botrytis L.) cv. Pusa Early Synthetic. Seed Research. 2006;34(1):104-106.

5 El-Hamd, A.S.A.A and Esmail, A.A.M. Effect of planting dates on the yield and quality of broccoli. Annals of Agricultural Science. 2005; 43 (2): 781-790.

6 El-Magd and M.M. Abou. Evaluation of some broccoli cultivars growth, head yield and quality under different planting dates. Journal of Applied Sciences Research.2013; 9(11): 5730-5736.

7 Hossain, M.F, Ara, N, Uddin, M.R, Dey, S and Islam, M.R. 2011. Effect of time of sowing and plant spacing on broccoli production. Tropical Agricultural Research and Extension. 2011;14 (4): 90-92.

Comment [AS97]: Check it

8 Lawande, K.E, Khaire, V.A and Bhore, D.P. Effect of sowing of dates on yield of cabbage. Journal of Maharashtra Agriculture Universities.1998; 13 (1): 100-101.

9 Nooprom Karistsapola, Santipracha Quanchitb and Te-Chato Sompongb. Effect of planting date and variety on growth and yield of broccoli during the dry season in southern Thailand. *I*JPAES.2013; 3:5 121-124.

10 Nooprom, K, Santipracha, Q and Sompong, T.C. Effect of planting date and variety on growth and yield of broccoli during the dry season in southern Thailand. International Journal of plant, animal and environmental science. 2013; 3(2): 121- 124.

11 Panse, G and Sukhatme, P.V.Statistical methods for agricultural workers. Indian Council of Agricultural Research. New Delhi.1985.

12 Saikia, Phookan, D.B and Sanchita Brahma. 2010. Effect of time of planting and planting densities on growth, yield and economic production of broccoli (*Brassica oleracea var. italica*) cv. Pusa Broccoli KTS-1. Journal of Hill Agriculture. 2010;1 (2): 135-139.

13 Singh, A.K, Khan, A.R and Akhilesh Singh. Influence of different dates of transplanting on head yield of broccoli (*Brassica oleracea var. italica* L.). Crop Research (Hissar). 1999;17(1):104-106.

14 Singh, A.K. 2001. Head yield of broccoli as influenced by different dates of transplanting under low-hills subtropical condition of Himachal Pradesh. Horticultural Journal.2001; 14(3):66-67.

15 Singh, B.K, Pathak, K.A, Sarma, K.A and Manju, T. Effect of transplanting dates on plant growth, yield and quality traits of cabbage cultivars. Indian Journal of Hill Farming.2010;23 (2): 1-5.

16 Singhal, B.K. Preeti, Srivastava, B.K, Singh, M.P and Singh, P.K. Effect of date of planting and spacing on the performance of broccoli. Indian Journal of Horticulture. 2009; 66(1): 137-140.

17 Solunke, B.G, Wagh, A.P, Dod, V.N and Nagre, P.K. 2011. Effect of dates of planting and spacing on growth and yield of broccoli. The Asian Journal of Horticulture. 2011;6 (2): 294-297.