International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(2): 1498-1500

Received: 01-01-2018
Accepted: 03-02-2018

**Deepa Beniwal**
Department of Vegetable Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

**Lalit Bhatt**
Department of Vegetable Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

**SK Maurya**
Department of Vegetable Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

**Dhirendra Singh**
Department of Vegetable Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

**Sajal Debbarma**
Department of Vegetable Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

**Correspondence**
**Deepa Beniwal**
Department of Vegetable Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

# Economics of chilli grown with different fertigation levels and polyethylene mulch

**Deepa Beniwal, Lalit Bhatt, SK Maurya, Dhirendra Singh and Sajal Debbarma**

**Abstract**
A study was conducted to determine the economics of different fertigation levels under mulched and unmulched conditions in chilli at *tarai* conditions of Uttarakhand during spring-summer seasons of 2016. The experiment was carried out in two factorial randomized block design with four fertigation levels (fertigation at 120, 100, 80 and 60 percent of RDF) along with control and RDF applied through traditional method under bicolour polyethylene mulch and unmulched condition. The results of experiment disclosed that performance of chilli was influenced by different levels of fertigation and also influenced by polyethylene mulch and unmulched conditions. As far as net return and B:C ratio was concerned, maximum net return of Rs. 2,39,205.16 per ha and B:C ratio of 3.28 was recorded in treatment combination $P_9M_2$ *i.e.,* fertigation at 80 % of recommended dose of fertilizer applied twice a week along with polyethylene mulch.

**Keywords:** Chilli, fertigation, mulch, bicolour polyethylene, Economics, B:C ratio

## Introduction
Chillies (*Capsicum annum* L.) are edible berries belongs to solanaceaeous family. It grows well in warm and humid climate and a temperature of 20°-25°C. So far its cultivation in India is concerned, India is leading country in context of area covered, making it most dominant player in the word of chilli market. A number of chilli varieties are being grown in different states and region of the country. The productivity of these varieties can be exploited by supplementing with proper fertilizer and irrigation management. In India, chilli is grown during hotter parts of the year. Under such circumstances, moisture stress and efficient utilization of applied nutrients are the major concerns. Thus, for successful chilli production fertilizers should be applied in synchrony with crop demand in smaller quantities during the crop season as per crop requirement (Reddy *et al*., 2016) [3]. Apart from fertilizers, water also play a major role in deciding the productivity of chilli. But in present scenario water has become scare and expensive for irrigation requirement due to fast depletion of surface and sub-surface water resources, hence available water on earth should be preciously used through drip irrigation system (Imtiyaz *et al*., 2000) [2]. Fertigation ensures application of fertilizers directly to the plant root zone and exact crop requirements can be met accurately. Use of plastic mulch in vegetable cultivation is also one of the most efficient management tools for conserving soil moisture (Bhatt *et al*., 2011) [1]. Keeping these facts in view, present investigation was carried out to study the effect of different fertigation levels and polyethylene mulch on economics of chilli.

## Material and Methods
The present study was carried out at Vegetable Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) during cropping season of December 2015 to June 2016. The experiment was laid out in two factorial randomized block design with three replications. The first factor had four fertigation levels, *i.e.,* fertigation at 120 per cent of RDF, 100 per cent of RDF, 80 per cent of RDF and 60 per cent of RDF with application frequency of once and twice a week, along with application of recommended dose of fertilizer (RDF) as traditional method ($P_1$) and control ($P_2$). Different fertigation levels with different application frequencies were fertigated at 120 per cent of RDF applied once a week ($P_3$), at 100 per cent of RDF applied once a week ($P_4$), at 80 per cent of RDF applied once a week ($P_5$), at 60 per cent of RDF applied once a week ($P_6$), at 120 per cent of RDF applied twice a week

($P_7$), at 100 per cent of RDF applied twice a week ($P_8$), at 80 per cent of RDF applied twice a week ($P_9$) and at 60 per cent of RDF applied twice a week ($P_{10}$). Second factor was growing conditions, *i.e.*, without mulch ($M_1$) and with bi-colour polyethylene mulch ($M_2$). Recommended dose of fertilizer (RDF) was 150 kg N/ha, 80 kg P/ha and 80 kg K/ha along with 25 t FYM/ha. The seedlings, of variety Indu, were raised in 15 cm raised nursery bed and transplanted on 4th March in the plot of 21×1 sqm size at a spacing of 0.60 m × 0.50 m. The bi-colour polyethylene mulch (black surface below and silver colour surface above) which was used in the experiment was of 40 micron thickness. After taking into consideration of variables, fixed input and their corresponding rates, the cost incurred under each treatment was worked out for an area of one ha. To get gross return/ha, the fruit yield (q/ha) obtained in each treatment was multiplied with prevailing local mandi rates. Net return in each treatment was calculated by subtraction of cost of cultivation from the gross return. Benefit-Cost ratio was computed in each treatment with division of gross return by cost of cultivation.

**Results and Discussion**

Positive influence of frequent application of fertilizer through drip irrigation, polyethylene mulch and their interaction was noticed for yield of chilli in this study. Significantly higher yield (106.79 q/ha) was recorded under polyethylene mulch condition. An average increase of 34.89 per cent in total yield was recorded under mulched condition over unmulched condition. Similarly, yield (114.99 q/ha) was significantly higher at fertigation level of 80 per cent of RDF applied twice a week. Application of nutrients at fertigation level of $P_9$, *i.e.*, fertigation at 80 per cent of RDF applied twice a week increase the yield by 51.44 per cent over conventional method of nutrient application. Out of 20 treatment combinations, the maximum yield (130.00 q/ha) was recorded in treatment combination $P_9M_2$, *i.e.*, fertigation at 80 per cent of RDF applied twice a week with polyethylene mulch condition.

Increase in yield related characters and total yield in polyethylene mulch might be on account of higher vegetative growth due to favorable soil microclimate promoting more up take of nutrients, higher photosynthesis and better growth and development. Hence, in this situation dry matter accumulation and partitioning was better in different plant parts, which led to higher yield (Thapliyal *et al*., 2014) [4]. Application of nutrients through fertigation provide better availability of nutrients near the root zone with reduction in leaching losses and makes more nutrient availability to plant roots and better utilization of nutrients from soil, promoting faster growth and development expressed in terms of yield (Wien *et al*., 2004) [5]. Higher fruit yield obtained due to interaction between polyethylene mulching and fertigation level was due to availability of optimum nutrients and uptake through fertigation of nutrients in smaller splits as per crop growth requirement in mulched plots, helped in establishing roots, initiating more fruiting points, their subsequent retention and development in the plant leading to the higher yield per plant (Reddy *et al*., 2016) [3].

The data indicated in Table 1 shows that the maximum cultivation cost of Rs. 80,021.94 per ha in this study was incurred in fertigation level $P_7$, *i.e.*, application of nutrients at 120 per cent of RDF applied twice a week and least (Rs. 40,825.14 per ha) in control, *i.e.*, no application of fertilizers. Similarly, significantly higher cultivation cost in chilli (Rs. 7,27,199.20 per ha) was worked out in polyethylene mulch treatment as compared to unmulched condition (Rs. 6,28,399.20 per ha).

The gross and net returns at different levels of fertigation, growing conditions and combination of both (P×M), were worked out based on prevalent wages, rate of critical inputs and average selling price of produce. Out of 20 fertigation levels, highest gross return (Rs. 2,68,488.75 per ha), net profit (Rs. 2,00,744.41 per ha) and B:C ratio (2.93) were obtained at $P_9$ level of fertigation, *i.e.*, fertigation at 80 per cent of RDF applied twice a week. From the two growing conditions, tested in this study, polyethylene mulch condition showed higher gross return (Rs. 2,58,919.20 per ha), net return (Rs.1,95,033.68 per ha) and B:C ratio (2.63) over unmulched condition. Among 20 treatment combinations, treatment $P_9M_2$ (fertigation at 80 per cent of RDF applied twice a week under polyethylene mulch condition) showed superiority over all other treatment combinations in terms of achieving net return (Rs. 2,39,205.16 per ha) and B:C ratio (3.28).

More cost of cultivation under mulched condition was due to added cost of polyethylene mulch that add to the total cost of cultivation. The increased net return and higher B:C ratio under mulched condition were attributed due to higher fruit yield, fewer requirements of resources and better management practices (Bhatt *et al*., 2011) [1]. The higher value for gross return, net return and B:C ratio at frequent application of nutrients could be due to higher fruit yield. The twin effect of polyethylene mulch and frequent application of nutrients through drip fertigation was quite evident when chilli was planted under polyethylene mulch condition at fertigation level of 80 per cent of RDF applied twice a week.

Based on the findings of present study, it could be concluded that fertigation of capsicum at 80 per cent of RDF when applied twice a week with bi-colour polyethylene mulch was most profitable in getting higher yield (130 q/ha) and B:C ratio (3.28). Hence, application of fertilizers through fertigation is economically viable in chilli.

**Table 1:** Effect of different fertigation levels and growing conditions on economics of chilli

| | **Cost of cultivation (Rs /ha)** | | | **Gross return (Rs/ha)** | | | **Net return (Rs/ha)** | | | **B:C Ratio** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatments** | **Growing condition** | | | **Growing condition** | | | **Growing condition** | | | **Growing condition** | | |
| **Fertigation level** | **$M_1$** | **$M_2$** | **Mean** | **$M_1$** | **$M_2$** | **Mean** | **$M_1$** | **$M_2$** | **Mean** | **$M_1$** | **$M_2$** | **Mean** |
| $P_1$ | 68072.64 | 77498.64 | 72785.64 | 173232.00 | 215163.00 | 19419.70 | 105159.36 | 137664.36 | 121411.86 | 1.54 | 1.77 | 1.65 |
| $P_2$ | 36146.64 | 45503.64 | 40825.14 | 69504.00 | 90507.60 | 50005.80 | 33357.36 | 45003.96 | 39180.66 | 0.92 | 0.98 | 0.95 |
| $P_3$ | 74956.44 | 84883.44 | 79919.94 | 226848.00 | 320652.00 | 273750.00 | 151891.56 | 235768.56 | 193830.06 | 2.02 | 2.87 | 2.43 |
| $P_4$ | 68649.64 | 78517.64 | 73583.64 | 205650.00 | 295516.00 | 158038.00 | 137000.36 | 216998.36 | 176999.36 | 1.99 | 2.86 | 2.40 |
| $P_5$ | 62266.84 | 72327.84 | 67297.34 | 180033.00 | 286075.00 | 323070.50 | 117766.16 | 213747.16 | 165756.66 | 1.89 | 2.95 | 2.42 |
| $P_6$ | 56035.04 | 65880.04 | 60957.54 | 157435.00 | 245203.00 | 201319.00 | 101399.96 | 179322.96 | 140361.46 | 1.80 | 2.72 | 2.26 |
| $P_7$ | 75030.44 | 85013.44 | 80021.94 | 242475.00 | 343476.90 | 292975.95 | 167444.56 | 258463.46 | 212954.01 | 2.23 | 3.04 | 2.64 |
| $P_8$ | 68577.64 | 78784.64 | 73681.14 | 200227.50 | 314953.50 | 157590.50 | 131649.86 | 236168.86 | 183909.36 | 1.91 | 2.99 | 2.45 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_9$ | 62693.84 | 72794.84 | 67744.34 | 224977.50 | 312000.00 | 268488.75 | 162283.66 | 239205.16 | 200744.41 | 2.58 | 3.28 | 2.93 |
| $P_{10}$ | 55973.04 | 65995.04 | 60984.04 | 159436.80 | 165645.00 | 162540.90 | 103463.76 | 187993.96 | 145728.86 | 1.74 | 2.84 | 2.29 |
| Mean | 628399.2 | 727199.2 | | 1839818.8 | 258919.2 | | 121141.66 | 195033.68 | | 1.86 | 2.63 | |

**Table 2:** Average cost of Cultivation (Rs/ha) of chilli fertigated with different fertigation levels and polyethylene mulch based on fixed cost and variable cost during 2016-17

| **Based on variable cost (`) in the year 2016** | | | | |
|---|---|---|---|---|
| **Drip irrigation installation cost (per ha)** | | | | |
| **S. No.** | **Operations** | **Quantity** | **Rate (Rs)** | **Cost (Rs/100m$^2$)** |
| 1. | Drip irrigation system | | | |
| | a. Sub main pipe (50 mm) | 150 m | 19.20/m | 2880.00 |
| | b. Lateral pipe (16 mm) | 10000 m | 4.5/m | 450.00 |
| | c. Start, washer and end cap (16 mm) | 138 | 6.80/1 set | 938.00 |
| | d. Connector (16mm) | 110 | 1.50/-each | 165.00 |
| | e. Ball valve | 5 | 180/-each | 900.00 |
| | f. Dummies | 1250 | 0.30/-each | 375.00 |
| | g. 2" Venturi with accessories | 1 | 2000/-each | 2000.00 |
| | h. Screen Filters (2" size) | 1 | 3500/-each | 3500.00 |
| | i. Erection charges | - | - | 2500.00 |
| | j. 3 HP motor pum p set | 1 | 10000/- | 10000.00 |
| | Total (fixed cost) | | | 68258.00 |
| | Running cost | | | |
| | a. Electricity charge | 5.0/KWH | - | |
| | b. Labour | 1 labour | 150 | |
| | c. | | Total | 68258.00 |

**Table 3:** Total cost of fertigation in different treatments

| **Treatments** | **Fertilizer dose** | | **Fertilizer cost** | | **Total** |
|---|---|---|---|---|---|
| | **Urea (kg)** | **NPK (kg)** | **Urea (7** Rs**/kg)** | **NPK (75** Rs**/kg)** | |
| $T_1$ | 152.00 | 400.00 | 1064.00 | 30000 | 31064.00 |
| $T_2$ | - | - | - | - | - |
| $T_3$ | 182.40 | 480.00 | 1276.80 | 36000 | 37276.80 |
| $T_4$ | 152.00 | 400.00 | 1064.00 | 30000 | 31064.00 |
| $T_5$ | 121.60 | 320.00 | 851.20 | 24000 | 24851.20 |
| $T_6$ | 91.20 | 240.00 | 638.40 | 18000 | 18638.40 |
| $T_7$ | 182.40 | 480.00 | 1276.80 | 36000 | 37276.80 |
| $T_8$ | 152.00 | 400.00 | 1064.00 | 30000 | 31064.00 |
| $T_9$ | 121.60 | 320.00 | 851.20 | 24000 | 24851.20 |
| $T_{10}$ | 91.20 | 240.00 | 638.40 | 18000 | 18638.40 |
| $T_{11}$ | 152.00 | 400.00 | 1064.00 | 30000 | 31064.00 |
| $T_{12}$ | - | - | - | - | - |
| $T_{13}$ | 182.40 | 480.00 | 1276.80 | 36000 | 37276.80 |
| $T_{14}$ | 152.00 | 400.00 | 1064.00 | 30000 | 31064.00 |
| $T_{15}$ | 121.60 | 320.00 | 851.20 | 24000 | 24851.20 |
| $T_{16}$ | 91.20 | 240.00 | 638.40 | 18000 | 18638.40 |
| $T_{17}$ | 182.40 | 480.00 | 1276.80 | 36000 | 37276.80 |
| $T_{18}$ | 152.00 | 400.00 | 1064.00 | 30000 | 31064.00 |
| $T_{19}$ | 121.60 | 320.00 | 851.20 | 24000 | 24851.20 |
| $T_{20}$ | 91.20 | 240.00 | 638.40 | 18000 | 18638.40 |

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