# PERFORMANCE OF CORIANDER CULTIVARS FOR GREEN LEAF PRODUCTION UNDER LATE SOWING CONDITION

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## ABSTRACT

*A field experiment was conducted at the research farm of Institute of Agriculture and Animal Science, , Chitwan, Nepal from December 2009 to March 2010 to study the green leaf production potential of coriander (Coriandrum sativum L.) cultivars. Ten cultivars of coriander were evaluated in a Randomized Complete Block Design (RCBD) replicated three times. Coriander Local, Marpha Local, Mallika, Surabhi and Kalmi Chhattedar showed better performance as compared to others on growth, yield and quality parameters. The highest green leaf yield (10.09 mt/ha) was recorded in Coriander Local followed by Mallika (9.54 mt/ha), Surabhi (9.40 mt/ha) and Kalmi Chhattedar (9.24 mt/ha). Surabhi was found promising cultivar under late sowing condition because if its highest rosette diameter, number of basal leaves and length of basal leaf Hence, there is good scope of coriander cultivation for green leaf production, however, it is more suitable to sow the seeds in usual tome of sowing for the better performance of all the cultivars.*

**Key words**: *Coriandrum sativum*, cultivars, parameters, performance, yield

## INTRODUCTION

Coriander (*Coriandrum sativum* L.) is a strong smelling annual herb extensively grown in many climates throughout the world (UNIDO/FAO, 2005). It belongs to the carrot family umbelliferae. The plant is named after koris, the Greek word for bug, as the unripe fruits have a smell that has been compared to that of bedbugs (GOA, 1998/2009).The characteristic smell of the green plant is caused by the aldehydic contents of the essential oil. During ripening, these chemicals decrease, and after ripening and drying, they are no longer found in the fruits (Lorincz and Tyihak, 1965). The plant contains high amount of ascorbic acid (up to 160 mg/100 gm) (Prakash, 1990).

Tender leafy shoots and seeds of coriander are used in the form of spices. But excessive shoot growth reduces fruit size fruit quality and yield due to antagonism from leaf-produced assimilates (Cowan et al., 2001). The cultivar CO-2 is a dual-purpose cultivar suited both for use as greens and for production of grains. It can be grown in water logged, drought, saline and alkaline conditions. It gives an average green yield of 10 mt/ha (Singh et al., 2001). Ahlawat et al.(1999/2000) reported that Panta Haritima is a good yielder of leaves (12.5-14.0 mt/ha) having the smooth leaves with good fragrance and attractive green color. Farmers in the plain areas usually sow coriander seeds in normal season resulting in price reduction due to massive production and delivery of green leaves in the market. Therefore, the farmers try off-season production to combat the problem. However, poor vegetative growth, reduced plant height and premature bolting under high temperature condition reduce the green leaf yield and its quality. Suitable cultivars for green leaf production other than normal season, needs to be selected. The study was therefore conducted to evaluate performance of different cultivars under late sowing condition.

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## MATERIALS AND METHODS

The experiment was carried out in the Vegetable Farm of Institute of Agriculture and Animal Science, Rampur during December 2009 to April 2010. The region is characterized by hot and humid sub-tropical climate and lies in inner terai geographical location. The soil in the experimental field was sandy loam with pH 5.6, low organic matter (1.72%), low nitrogen (0.09%), high phosphorous (272.56 kg/ha) and medium potash (121.2 kg/ha).

The experiment was laid out in a Randomized Complete Block Design, which was comprised of ten treatments Coriander Local, Selection-9, Selection-51, Kalmi-K5, Kalmi Chhattedar, Mallika, Mohini-25, Green Cross, Surabhi and Marpha Local replicated three times. The individual plot size was 2.25 m2. Each plot was divided into 5 rows so that it could be maintained plant geometry (30×2.5 cm2) after thinning.

The seeds of different cultivars trampled into halves, were soaked with water overnight before sowing. The seed sowing was done on 22 December 2009 at the rate of 14 kg/ha. FYM at the rate of 20 mt/ha along with N:P:K (60:30:20) from chemical fertilizers was applied on the experimental plot. One week before sowing, well-decomposed FYM was impregnated with soil followed by light The seeds of different cultivars, trampled into halves, were soaked with water overnight before sowing. The seed sowing was done on 22 December 2009 at the rate of 14 kg/ha. FYM at the rate of 20 mt/ha along with N:P:K (60:30:20) from chemical fertilizers was applied on the experimental plot. One week before sowing, well-decomposed FYM was impregnated with soil followed by light irrigation for proper mineralization. Phosphorus and potash were applied as basal application whereas nitrogen was applied into 3 split doses; at the time of sowing, and at 30 and 60 DAS. Moisture regime of experimental plot was always maintained more than 25 percent with frequent application of irrigation water. Weed control was undertaken manually during the entire crop-growing period.

The crowded young plants were thinned followed by earthing up, weeding and irrigation. Three observations were taken on plant characters in weekly interval at 50, 57 and 64 DAS. For the measurement of the growth parameters,10 plants were selected randomly from each plot so that there were 30 plants selected randomly for each cultivar through the sample row.

Plant height, rosette diameter and length of the longest basal leaf were measured with the help of scale whereas stem diameter was taken with Vernier Calipers. Likewise, total number of leaves, number of basal leaves, number of pinnatifid leaves and number of decompound leaves were counted through the visual observation. Fresh weight of each selected plant immediately after uprooting was recorded weighing with the help of electric balance in the central lab of IAAS.

From the every selected 10 sample plants for dry weight and sample weighing 50 gm for dry matter from each plot were placed in the envelope and allowed to dry in hot air oven at 75°C for 72 hours. The sample weighing 50 gm was taken at the time of harvesting at 65 DAS. Dry matter percent of each sample was calculated on fresh weight basis.

Vitamin 'C' content in the leaves of each cultivar was determined by titration method at Central Food Testing Laboratory, (CFTL), Babarmahal, Kathmandu. Leaf sample of 200 gm of each cultivar representing three replications was used for Vitamin 'C' analysis and for each sample the analysis was repeated three times.

The green leaf yield was recorded by weighing the uprooted plants instantly under field condition with the help of portable electronic balance and expressed as mt/ha. The production was taken from the net plot at different date depending upon the cultivar maturity. The collected data were subjected to analysis of variance by using the statistical

software MSTATC and mean separation by Duncan's Multiple Range Test (DMRT). (Gomez and Gomez, 1984)

## RESULTS AND DISCUSSIONS

### PLANT HEIGHT

Table 1 shows the plant height of different cultivars recorded at weekly interval from 50-64 DAS. The cultivars were significantly different for plant height at 50 DAS and 64 DAS while they were highly significant at 57 DAS.

The cultivar Mallika (21.83 cm) ranked the tallest followed by Kalmi Chhattedar (20.51 cm) and Coriander Local (19.73 cm), respectively at 50 DAS. Kalmi Chhattedar and Coriander local were not significantly different and were at par with Selection-51(18.49 cm), Mohini-25(17.60 cm), Green Cross(17.41 cm), Selection-9 (17.08 cm) and Kalmi K5 (16.80 cm). The cultivar Surabhi (13.03 cm) had the lowest plant height and was at par with Mohini-25 (17.60 cm), Green Cross (17.41 cm), Selection-9 (17.08 cm) , Kalmi K5 (16.80 cm) and Marpha Local (14.57 cm).

Table 1: Plant height of coriander cultivars at different growth stages, IAAS, Rampur, 2009/2010

| Cultivars | Plant height (cm) | | |
|---|---|---|---|
| | 50 DAS | 57 DAS | 64 DAS |
| Coriander Local | 19.7$^{ab}$ | 25.77$^{abc}$ | 30.17$^{ab}$ |
| Selection-9 | 17.08$^{bcd}$ | 23.31$^{bc}$ | 31.04$^{a}$ |
| Selection-51 | 18.49$^{abc}$ | 25.30$^{abc}$ | 27.45$^{abc}$ |
| Kalmi $K_5$ | 16.80$^{bcd}$ | 22.44$^{bcd}$ | 29.43$^{ab}$ |
| Kalmi Chhattedar | 20.51$^{ab}$ | 26.39$^{ab}$ | 31.87$^{a}$ |
| Mallika | 21.83$^{a}$ | 29.36$^{a}$ | 31.90$^{a}$ |
| Mohini-25 | 17.60$^{abcd}$ | 20.56$^{cd}$ | 23.75$^{bc}$ |
| Green Cross | 17.41$^{abcd}$ | 21.90$^{bcd}$ | 23.65$^{bc}$ |
| Surabhi | 13.03$^{d}$ | 17.48$^{d}$ | 22.40$^{c}$ |
| Marpha Local | 14.57$^{cd}$ | 17.70$^{d}$ | 23.95$^{bc}$ |
| Mean | 17.705 | 23.021 | 27.561 |
| SEm± | 1.414 | 1.571 | 2.075 |
| LSD (≤ 0.05) | 4.200* | 4.668** | 6.165* |
| CV (%) | 13.83 | 11.82 | 13.04 |

Mean of three replications; Means followed by common letters in a column are not significantly different at 5% level by DMRT.** , Highly significant *,Significant and ns, non significant

The tallest plant height was in the Mallika (29.36 cm) followed by Kalmi Chhattedar (26.39 cm) and was significantly different from other cultivars except Kalmi Chhattedar, Coriander Local(25.77 cm) and Selection-51(25.30 cm) at 57 DAS. The lowest plant height was measured in the Surabhi (17.48 cm) which was not significantly different from Marpha Local (17.70 cm).

The cultivars; Mallika (31.90 cm), Kalmi Chhattedar (31.87 cm) and Selection-9 (31.04 cm) did not differ statistically, but were significantly different from the rest of all the cultivars except Coriander Local (30.17 cm), Kalmi K5 (29.43 cm) and Selection-51 (27.45 cm).The shortest plant height was recorded in the cultivar Surabhi (22.40 cm) which showed significant difference with the rest of all the other cultivars.

The cultivars Mallika and Kalmi Chhattedar showed better performance followed by Coriander Local in plant height at different growth stages, it is supposed to be linked with the good emergence. Most of the Indian cultivars showed better performance under Chitwan condition. However, there was poor performance of Surabhi though it was imported from India; it was due to lack of genetic potentialities to be expressed as there was low emergence. However, plant height was quite low in comparison to emergence in case of the cultivar Marpha local and it was solely due to the spreading growth habit. The plant height acquired by the cultivars is supported by the findings of Diaderichsen (1996) who reported that the glabrous plant could reach heights between 0.20 and 1.40 m.

NUMBER OF BASAL LEAVES/PLANT

Statistical analysis of the data in Table 2 indicates that there was highly significant difference among the cultivars with respect to their number of basal leaves/plant at 50 DAS, 57 DAS and 64 DAS.

The highest number of basal leaves (5.81/plant) was in cultivar Marpha Local followed by Coriander Local (5.78/plant) which was significantly different with other cultivars but was at par with Surabhi (5.70/plant) at 50 DAS. The cultivar Surabhi was at par with Green cross (4.89/plant) and significantly different from the rest of the cultivars. The cultivar Kalmi-K5 (3.85/plant) produced the lowest number of basal leaves.

The cultivar Surabhi (6.54/plant) showed the outstanding performance and was highly significantly different from the rest of the cultivars at 57 DAS. However, Surabhi was at par with Coriander Local. The cultivar Kalmi Chhattedar (4.91/plant) was next to the Coriander Local and at par with Marpha Local (4.45/plant), Selection-51(4.20/plant), Mallika (3.84/plant), Selection-9 (3.82/plant) and Green Cross (3.68/plant). The cultivar Kalmi-K5 (2.85/plant) produced the lowest number of basal leaves.

Table 2: Number of basal leaves of coriander cultivars at different growth stages at IAAS, Rampur, 2009/2010

| Cultivars | Number of basal leaves/plant | | |
|---|---|---|---|
| | 50 DAS | 57 DAS | 64 DAS |
| Coriander Local | $5.78^{a}$ | $5.54^{ab}$ | $5.60^{a}$ |
| Selection-9 | $4.78^{cd}$ | $3.82^{cde}$ | $2.93^{bc}$ |
| Selection-51 | $4.31^{cd}$ | $4.20^{bcde}$ | $2.60^{bc}$ |
| Kalmi $K_5$ | $3.85^{d}$ | $2.85^{e}$ | $1.73^{bc}$ |
| Kalmi Chhattedar | $4.49^{cd}$ | $4.91^{bc}$ | $2.67^{bc}$ |
| Mallika | $4.28^{cd}$ | $3.84^{cde}$ | $1.60^{c}$ |
| Mohini-25 | $4.39^{cd}$ | $3.21^{de}$ | $2.47^{bc}$ |
| Green Cross | $4.89^{bc}$ | $3.68^{cde}$ | $2.27^{bc}$ |
| Surabhi | $5.70^{ab}$ | $6.54^{a}$ | $6.40^{a}$ |
| Marpha Local | $5.81^{a}$ | $4.45^{bcd}$ | $3.00^{b}$ |
| Mean | 4.827 | 4.304 | 3.127 |
| SEm± | 0.2787 | 0.4457 | 0.4041 |
| LSD (≤ 0.05) | 0.828** | 1.324** | 1.201** |
| CV (%) | 10.00 | 17.93 | 22.39 |

Mean of three replications; Means followed by common letters in a column are not significantly different at 5% level by DMRT.** , Highly significant*,Significant and ns, non significant

The highest number of basal leaves was in the cultivar Surabhi (6.40/plant) which was not significantly different from Coriander Local (5.60/plant), whereas the lowest number of basal leaves was in Mallika (1.60/plant) at 64 DAS. Marpha Local produced the number of basal leaves (3.00/plant) which was at par with the rest of the cultivars except Mallika. The performance of the remaining cultivars was same and were not significantly different among themselves.

The number of basal leaves was minimum in Mallika and Kalmi Chhattedar as a result of initiation of withering of basal leaves and premature bolting at 64 DAS. The cultivars; Coriander Local, Marpha Local and Surabhi had the maximum number of basal leaves. The reason behind this fact may be the Marpha Local and Coriander Local are native cultivars and were well adapted in local condition but Surabhi remained in juvenile stage for a longer period of time. The result is supported by Diederichsen (1996) that those genotypes with a lengthened juvenile stage produce additional basal leaves, provided the weather conditions do not accelerate ontogenesis. The Ethiopian types had well-developed rosettes of from four to nine basal leaves of characteristic shape .There existed extreme, characteristic Syrian types that had up to 25 basal leaves and formed very large rosettes.

LENGTH OF THE LONGEST BASAL LEAF

The analysis of the data in Table 3 reveals that the length of the longest basal leaf was significantly different among the cultivars at 50 DAS and highly significant at 57 DAS and 64

DAS, respectively. The highest length of the longest basal leaf was recorded in the cultivar Coriander Local and the lowest in the Kalmi-K5 at 50 DAS, 57 DAS and 64 DAS, respectively.

Table 3: Length of the longest basal leaf of coriander cultivars at different growth stages at IAAS, Rampur, 2009/2010

| Cultivars | Length of the longest basal leaf(cm) | | |
|---|---|---|---|
| | 50 DAS | 57 DAS | 64 DAS |
| Coriander Local | $17.77^{a}$ | $22.63^{a}$ | $26.08^{a}$ |
| Selection-9 | $12.94^{bc}$ | $15.92^{cd}$ | $18.50^{bc}$ |
| Selection-51 | $13.10^{bc}$ | $17.57^{bc}$ | $15.37^{bcd}$ |
| Kalmi $K_5$ | $10.15^{c}$ | $11.53^{d}$ | $9.23^{d}$ |
| Kalmi Chhattedar | $15.56^{ab}$ | $21.15^{ab}$ | $18.76^{bc}$ |
| Mallika | $16.36^{ab}$ | $21.39^{ab}$ | $16.60^{bc}$ |
| Mohini-25 | $14.15^{abc}$ | $14.71^{cd}$ | $14.53^{bcd}$ |
| Green Cross | $15.44^{ab}$ | $17.69^{bc}$ | $12.68^{cd}$ |
| Surabhi | $12.24^{bc}$ | $16.65^{bc}$ | $20.58^{ab}$ |
| Marpha Local | $13.86^{abc}$ | $16.82^{bc}$ | $16.29^{bc}$ |
| Mean | 14.157 | 17.606 | 16.862 |
| SEm± | 1.293 | 1.517 | 2.078 |
| LSD (≤ 0.05) | 3.843* | 4.509** | 6.173** |
| CV (%) | 15.83 | 14.93 | 21.34 |

Mean of three replications; Means followed by common letters in a column are not significantly different at 5% level by DMRT.** , Highly significant*,Significant and ns, non significant

The highest length of the longest basal leaf was in the cultivar Coriander Local (17.77 cm) followed by Mallika (16.36 cm) and the lowest length in the cultivar Kalmi-K5 (10.15 cm) at 50 DAS. Mallika was not statistically different with Kalmi Chhattedar (15.56 cm) and Green Cross (15.44 cm). Similarly, they were at par with Mohini-25 (14.15 cm), Marpha Local (13.86 cm), Selection-51(13.10 cm), Selection-9(12.94 cm) and Surabhi (12.24 cm).

Cultivar Coriander Local produced longest basal leaf (22.63 cm) followed by Mallika (21.39 cm), however, it was at par with Kalmi Chhattedar (21.15 cm) at 57 DAS. Mallika and Kalmi Chhattedar were at par with Green Cross (17.69 cm), Selection-51 (17.57 cm), Marpha Local (16.82 cm) and Surabhi(16.65 cm). The lowest length of the longest basal leaf was in cultivar Kalmi-K5 (11.53 cm).

The cultivar Coriander Local (26.08 cm) followed by Surabhi (20.58 cm) was significantly different with other eight cultivars except Surabhi at 64 DAS. The cultivars Kalmi Chhattedar (18.76 cm), Selection-9(18.50 cm), Mallika (16.60 cm) and Marpha Local (16.29 cm) had statistically the same level of performance, whereas in overall, the lowest performance was of Kalmi-K5 (9.23 cm).

In different growth stages, the maximum length of the longest basal leaf/plant was recorded in the cultivars Coriander Local, Mallika and Kalmi Chhattedar, respectively, except at 64 DAS. At later stage, Surabhi resumed optimum growth thereby producing maximum number of basal leaves and eventually resulted into the production of the highest length of the longest basal leaf after Coriander Local. Mallika and Kalmi Chhattedar showed maximum length of the longest basal leaf just contrary to the number of basal leaves and it might be due to the loss of the basal leaves in late data recording condition but it was optimum time for other cultivars. The length of the longest basal leaf is positively correlated with number of basal leaves, however, there was not optimum length in accordance with the number of basal leaves in the cultivar Marpha Local. The possible reasons may be the emergence of maximum number of basal leaves through the crown region as the cultivar attained prostrate growth habit. The lowest number of basal leaves and the length of the longest basal leaf was in the cultivar Kalmi-K5. The result is also in line with Diederichsen (1996) that the length of the longest basal leaf is closely correlated with the number of basal leaves. Plants that form rosettes of at least three leaves always have basal leaves which are longer than 10 cm and in the extreme Syrian types, the basal leaves can exceed 20 cm.

GREEN LEAF YIELD

On account of green leaf yield as in Table 4, there was significant difference among the cultivars. The highest green leaf production (10.09 mt/ha) was in the cultivar Coriander Local followed by Mallika (9.54 mt/ha), Surabhi (9.40 mt/ha) and Kalmi Chhattedar (9.24 mt/ha) along with the lowest yield in the cultivar Kalmi-K5 (5.89 mt/ha). The Coriander Local was at par with the rest of the cultivars except Selection-9 (mt 7.43/ha) and Kalmi-K5.

Table 4: Green leaf yield of different coriander cultivars at 65 DAS

| Cultivars | Green leaf yield (mt/ha) |
|---|---|
| Coriander Local | 10.09[a] |
| Selection-9 | 7.43[bc] |
| Selection-51 | 8.39[ab] |
| Kalmi $K_5$ | 5.89[c] |
| Kalmi Chhattedar | 9.24[ab] |
| Mallika | 9.54[ab] |
| Mohini-25 | 7.94[abc] |
| Green Cross | 8.37[ab] |
| Surabhi | 9.40[ab] |
| Marpha Local | 9.04[ab] |
| Mean | 8.5374 |
| SEm± | 0.7135 |
| LSD (≤ 0.05) | 2.120* |
| CV (%) | 14.48 |

Mean of three replications; means followed by common letters in a column are not significantly different at 5% level by DMRT; **, highly significant; *,Significant and ns, non significant

The maximum green leaf yield was in Coriander Local followed by Mallika and Surabhi, however, premature bolting was observed in former two cultivars and Surabhi did not flower even under hot days exhibiting the cultivar suitability under December sowing condition with respect to green leaf production. The green leaf yield (10 mt/ha) was reported by Singh et al.(2001) in the dual purpose cultivar CO-1 and under good management condition 12.5-14.0 mt/ha green leaves obtained in the cultivar Panta Haritima (Ahlawat et al., 1999/2000).

PEARSON'S CORRELATION IN BETWEEN GROWTH PARAMETERS

Table 5 reveals that the rosette diameter(r=0.787), stem diameter(r=0.908), number of basal leaves/plant (r=0.912) and leaf area (r=0.948) were highly significant and positively correlated with fresh weight while they were negatively correlated with dry weight with the values of (r=-0.069), (r=-0.217), (r=-0.379) and (r=-0.160), respectively.

Table 5: Pearson's correlation coefficients among the parameters of coriander cultivars during the period of green leaf production at IAAS, Rampur, 2009/2010

| | RD | SD | NBL | LLBL | LA | FW | DW |
|---|---|---|---|---|---|---|---|
| PH | 0.142 | -0.305 | -0.293 | 0.197 | -0.131 | -0.252 | 0.799** |
| RD | | 0.798** | 0.815** | 0.951** | 0.882** | 0.787** | -0.069 |
| SD | | | 0.800** | 0.734* | 0.867** | 0.908** | -0.217 |
| NBL | | | | 0.774** | 0.935** | 0.912** | -0.379 |
| LLBL | | | | | 0.812** | 0.691* | 0.013 |
| LA | | | | | | 0.948** | -0.160 |
| FW | | | | | | | -0.213 |

**Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

PH, Plant height; RD, Rosette diameter; SD, Stem diameter; NBL, Number of basal leaves/plant; LLBL, Length of the longest basal leaf/plant; LA, Leaf area; FW, Fresh weight/plant; DW, Dry weight/plant.

Similarly, length of the longest basal leaf(r=0.691) was significantly positively correlated with fresh weight while positively correlated with dry weight with the values of (r=0.013). Rosette diameter(r=0.882), stem diameter(r=0.867), number of basal leaves/plant (r=0.935) and length of the longest basal leaf/plant(r=0.812) revealed the highly significant positive correlation with leaf area, whereas plant height was negatively correlated with the values

of (r=-0.31). Rosette diameter(r=0.991) and number of basal leaves(r=0.774) contributed for obtaining the length of the longest basal leaf and showed highly significant positive association.

## CONCLUSIONS

Based on the study the following conclusions have been drawn:

1. In relation to growth, yield and quality parameters the cultivars Coriander Local, Marpha Local, Surabhi, Mallika, Kalmi Chhattedar showed mostly the better performance during the entire crop growing period.
2. The Surabhi also gave the highest number of basal leaves and length of the longest basal leaf although its performance was poor in the beginning and,therefore, the cultivar was promising for green leaf production under Chitwan condition.
3. Though there was vigorous growth of the cultivar Mallika and Kalmi Chhattedar at the initial stage, during the period of data recording at 64 DAS, the leaves started to wither and consequently affected the measurement of basal leaves and other vegetative parameters.
4. High relative humidity i.e. above 80% and low ambient temperature i.e. below 20˚C seriously affected plant growth.
5. Under late sowing condition (December) Surabhi was suitable cultivar for green leaf production in plain areas of Chitwan.

The results from the experiment indicates that there is possibilities of producing green leaves under late sowing condition in Chitwan, however, it is more suitable to sow the seeds in usual time of sowing.

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