



Effect of IPNS and Foliar Nutrition on the Yield and Quality Attributes of Coriander (*Coriandrum sativum* L.)

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A field experiment was conducted at Agricultural College and Research Institute, Killikulam during 2017-18 to study the effects of IPNS and foliar nutrition on yield and quality attributes of coriander in Rabi season in Alfisols of Tamirabarani command area, Tamil Nadu. The experiment was laid out in Randomized Block Design (RBD) with thirteen treatments and three replications. The treatments consists of absolute control, STCR-IPNS alone, FYM on 100 percent N equivalent basis alone and with foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extract alone and in combinations were given. The treatment that received FYM + foliar spray of amino acids (20 ppm), micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%), moringa and aloe vera leaf extracts (20 ppm) recorded higher green leaf and seed yield besides higher quality parameters such as leaf yield (4450 kg ha⁻¹), seed yield (653 kg ha⁻¹) total chlorophyll (2.25 mg g⁻¹), total carotenoid (0.79 mg g⁻¹) and essential oil content (0.40 %) and it has the highest B: C ratio of 2.71.

Key words: STCR-IPNS, Foliar nutrition, FYM, Seed yield, Essential oil

Coriander (*Coriandrum sativum* L.) is a tropical seed spice crop belongs to the family Apiaceae and mainly grown in Rabi season of Tamil Nadu. It is a native of Mediterranean region and commercially cultivated in India, Central America and East European countries. India is one of the largest producer of coriander mainly cultivated in Rajasthan, Gujarat, Madhya Pradesh, Haryana, Uttar Pradesh, Andhra Pradesh, Tamil Nadu and Bihar with an area of 6,77,000 ha and production of 8,88,000 MT (NHB, 2017). In Tamil Nadu it is cultivated in an area of 16,797 ha with the production of 8,985 MT and in Thoothukudi district it is cultivated in an area of 3,302 ha with the production of 5,165 tonnes (DES, 2015). In Thoothukudi district coriander is one of the majorly growing spice crops due to its dual purpose and it has more economic value. Inordinate and imbalanced use of fertilizers affects the soil health which in turn reduces the yield and quality of coriander. Since, coriander responds well to application of both organic manures and inorganic fertilisers, STCR- IPNS is one of the opt method to improve the yield and quality of coriander.

Material and Methods

A field experiment was conducted at Agricultural College and Research Institute, Killikulam, during 2017-18 to study the effect of STCR- IPNS and foliar nutrition on yield and quality of coriander in Rabi season in Alfisols of Tamirabarani command area, Tamil Nadu. The soil of the experimental field was sandy clay loam in texture belonging to Killikulam soil series and taxonomically grouped as Typic Hapustalfs (Soil Taxonomy, 1975). It is neutral in pH, low in available nitrogen (204 kg ha⁻¹), medium

in available phosphorus (16.5kg ha⁻¹) and high in available potassium (287 kg ha⁻¹). The available sulphur (25.22 mg kg⁻¹) is in sufficient level and among the micronutrients DTPA Zinc (0.63 mg kg⁻¹) and DTPA Iron (2.35 mg kg⁻¹) was deficient and other nutrients like DTPA Manganese (2.99 mg kg⁻¹) and DTPA Copper (1.5 mg kg⁻¹) are at sufficient level. The experiment was laid out in Randomized Block Design (RBD) with thirteen treatments and three replications. The treatments consists of absolute control (T₁), STCR-IPNS based recommendation (T₂), FYM on N equivalent basis (T₃), the treatments T₄, T₆, T₈, T₁₀ includes STCR-IPNS + foliar spray of amino acids (T₄), micronutrients (T₆), aloe vera leaf extract (T₈) and moringa leaf extract (T₁₀). For the treatments T₅, T₇, T₉, T₁₁, FYM on 100 percent N equivalent basis along with foliar spray of amino acids (T₅), micronutrients (T₇), aloe vera leaf extract (T₉) and moringa leaf extract (T₁₁). The treatment T₁₂, consists of STCR-IPNS recommendation + foliar spray of amino acids+ micronutrients + aloe vera leaf extract + moringa leaf extract and the treatment T₁₃ consists of FYM on 100 percent N equivalent basis along with foliar spray of amino acids + micronutrients + aloe vera leaf extract + moringa leaf extract was applied.

STCR-IPNS recommendation of 86 kg ha⁻¹ diammonium phosphate, 33 kg ha⁻¹ muriate of potash and 440 kg ha⁻¹ FYM and for the treatment FYM alone 4 tonnes of FYM was applied in their respective plots to supply 20:40:20 quantities of recommended dose of N, P₂O₅, K₂O. Foliar application of amino acids (20 ppm), micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%), moringa leaf extract (20 ppm) and aloe vera leaf extracts (20 ppm) was given at 25, 40 and 55 days after sowing. Coriander variety CO (CR) 4 was

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used as test crop. Data on various characters studied during the course of investigation was statistically analysed as suggested by Gomez and Gomez (1984).

Results and Discussion

Effect of IPNS and foliar nutrition on yield parameters of coriander

Table 1. Effect of IPNS and foliar nutrition on yield parameters of coriander Var. CO (CR) 4

Treatment	Umbels plant ⁻¹	UmbelletsUmbel ⁻¹	Seeds Umbellet ⁻¹	Test weight (g)
T ₁	8.9	3.6	3.6	6.8
T ₂	9.5	5.0	4.0	7.5
T ₃	9.8	4.9	4.3	7.4
T ₄	10.0	5.1	4.6	7.8
T ₅	10.2	5.3	4.6	7.7
T ₆	11.8	5.6	5.2	8.5
T ₇	12.0	5.5	5.3	8.7
T ₈	10.6	5.3	5.0	7.9
T ₉	11.1	5.2	5.0	7.8
T ₁₀	12.6	5.8	5.5	9.0
T ₁₁	13.9	6.0	5.5	9.1
T ₁₂	14.7	6.3	5.8	9.5
T ₁₃	15.3	6.6	5.9	9.7
S Ed	0.27	0.17	0.14	0.19
CD (0.05 %)	0.56	0.35	0.29	0.38

(T₁ - Control; T₂ - STCR-IPNS; T₃ -100% N through FYM; T₄ -T₂ + Foliar spray- Amino Acids(20ppm); T₅ -T₃ + Foliar spray - Amino Acids (20ppm); T₆ -T₂ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) ; T₇ -T₃ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%); T₈ -T₂ + Foliar spray - Aloe vera leaf extract(20ppm); T₉ -T₃ + Foliar spray - Aloe vera leaf extract(20ppm); T₁₀ -T₂ + Foliar spray - Moringa leaf extract(20ppm); T₁₁ -T₃ + Foliar spray - Moringa leaf extract(20ppm); T₁₂ -T₂ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) + Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm); T₁₃ -T₃ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%)+ Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm))

The yield parameters such as number of umbels per plant, number of umbellets per umbel and seeds per umbellet ranged from 8.9 to 15.3, 3.6 to 6.6 and 3.6 to 5.9, respectively and the 1000 seed test weight ranged from 6.8g to 9.7g (Table 1.)

Table 2. Effect of IPNS and foliar nutrition on seed and stover yield (kg ha⁻¹) of coriander Var. CO (CR) 4

Treatment	Leaf yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)	Seed yield (kg ha ⁻¹)
T ₁	2960	398	305
T ₂	3448	487	390
T ₃	3312	495	393
T ₄	3466	552	448
T ₅	3570	574	460
T ₆	3912	637	534
T ₇	3936	645	550
T ₈	3770	594	489
T ₉	3896	592	500
T ₁₀	3998	695	587
T ₁₁	4145	700	597
T ₁₂	4403	748	641
T ₁₃	4450	760	653
S Ed	89.15	15.81	15.30
CD (0.05 %)	184.01	35.63	30.61

(T₁ - Control; T₂ - STCR-IPNS; T₃ -100% N through FYM; T₄ -T₂ + Foliar spray- Amino Acids(20ppm); T₅ -T₃ + Foliar spray - Amino Acids (20ppm); T₆ -T₂ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) ; T₇ -T₃ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%); T₈ -T₂ + Foliar spray - Aloe vera leaf extract(20ppm); T₉ -T₃ + Foliar spray - Aloe vera leaf extract(20ppm); T₁₀ -T₂ + Foliar spray - Moringa leaf extract(20ppm); T₁₁ -T₃ + Foliar spray - Moringa leaf extract(20ppm); T₁₂ -T₂ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) + Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm); T₁₃ -T₃ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%)+ Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm))

The maximum number of umbels per plant (15.3), number of umbellets per umbel (6.6), seeds per umbellet (5.9) and 1000 seed test weight (9.7 g) was recorded in the treatment that received FYM along with foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extracts (T₁₃) and it was found to be on par with the treatment STCR-IPNS + foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extracts over control. The increase in yield parameters might be due to the improved vegetative growth and early flowering. Foliar application might have enhanced the availability of nutrients and plant growth hormones which improved the translocation of nutrient from root to plant parts which resulted in increased yield parameters. Similar findings were reported by Singh (2015), Massoud *et al.* (2016) and Lal *et al.* (2012).

Effect of IPNS and foliar nutrition on yield of Coriander

The leaf, stover and seed yields were significantly influenced by different treatments (Table 2). The highest leaf yield (4450 kg ha⁻¹), stover yield (760 kg ha⁻¹) and the seed yield (653 kg ha⁻¹) was recorded in the treatment that received FYM along with foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extracts (T₁₃) and it was found to be on par with the treatment STCR-IPNS + foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extracts over control. Application of organic manures and foliar application had an impact on the leaf yield because increased uptake of nutrients enhanced the emergence of new shoots. The moringa leaf extract has zeatin which induces the better growth of the plant which is in conformity with findings of Matthew (2016) and Jhankar *et al.* (2017).

Table 3. Effect of IPNS and foliar nutrition on essential oil content and oil yield of coriander Var. CO (CR) 4

Treatment	Essential oil content (%)	Essential oil yield (kg ha ⁻¹)
T ₁	0.27	0.82
T ₂	0.29	1.13
T ₃	0.30	1.18
T ₄	0.30	1.34
T ₅	0.31	1.43
T ₆	0.32	1.71
T ₇	0.31	1.71
T ₈	0.30	1.47
T ₉	0.32	1.60
T ₁₀	0.33	1.94
T ₁₁	0.35	2.09
T ₁₂	0.38	2.54
T ₁₃	0.40	2.61
S Ed	0.01	0.05
CD (0.05 %)	0.02	0.11

(T₁ - Control; T₂ - STCR-IPNS; T₃ -100% N through FYM; T₄-T₂ + Foliar spray- Amino Acids(20ppm); T₅ -T₃ + Foliar spray - Amino Acids (20ppm); T₆ -T₂ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) ; T₇ -T₃ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%); T₈ -T₂ + Foliar spray - Aloe vera leaf extract(20ppm); T₉ -T₃ + Foliar spray - Aloe vera leaf extract(20ppm); T₁₀ -T₂ + Foliar spray - Moringa leaf extract(20ppm); T₁₁ -T₃ + Foliar spray - Moringa leaf extract(20ppm); T₁₂ -T₂ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) + Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm); T₁₃ -T₃ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%)+ Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm)

The higher stover and seed yield was achieved due to increased growth and yield parameters such as umbels per plant, umbellate per umbel and 1000

seed weight. The improved soil structure influenced the better utilization of organic nutrients which had an impact on the yield. The increase in stover yield might be due to balanced supply of nutrient over the crop period enhanced the root development which increased the stalk and stem weight. These findings were corroborated with Godara *et al.* (2014) and Sinta *et al.* (2015).

Effect of IPNS and foliar nutrition on quality parameters of coriander

Total chlorophyll and carotenoid content

The chlorophyll and carotenoid contents were significantly influenced by different treatments and foliar applications (Fig 1). The highest total chlorophyll content of 2.25 mg g⁻¹ and the highest total carotenoid content of 0.79 mg g⁻¹ was recorded in the treatment that received FYM + foliar spray of amino acids, micronutrients; moringa and aloe vera leaf extracts (T₁₃) and it was statistically on par with the treatment that received STCR-IPNS + foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extracts over control. Slow release of nitrogen at constant rates increased the chlorophyll content with higher photosynthetic rates because nitrogen involves in the formation of chlorophyll and foliar application of micronutrients have beneficial role in influencing the chlorophyll content because of their presence in the structural components and also increased carotenoid content. Similar results were also reported by Patidar *et al.* (2016) and Jadhav *et al.* (2017).

Essential oil content and oil yield

The essential oil content and yield was influenced by the application of FYM and foliar application of different sources (Table 3). The highest oil content

Table 4. Effect of IPNS and foliar nutrition on economics of coriander Var. CO (CR) 4

Treatment	Cost of Cultivation (Rs. ha ⁻¹)	Gross return (Rs. ha ⁻¹)	Net return (Rs. ha ⁻¹)	B:C ratio
T ₁	19415	37750	18335	1.94
T ₂	22482	45180	22698	2.01
T ₃	21415	43910	22495	2.05
T ₄	22782	47100	24318	2.07
T ₅	21715	47500	25785	2.19
T ₆	23374	53020	29646	2.27
T ₇	22307	53980	31673	2.42
T ₈	22932	48670	25738	2.12
T ₉	21865	49500	27635	2.26
T ₁₀	23082	57590	34508	2.50
T ₁₁	22015	58760	36745	2.67
T ₁₂	24724	63260	38536	2.56
T ₁₃	23657	64090	40433	2.71

(T₁ - Control; T₂ - STCR-IPNS; T₃ -100% N through FYM; T₄ -T₂ + Foliar spray- Amino Acids(20ppm); T₅ -T₃ + Foliar spray - Amino Acids (20ppm); T₆ -T₂ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) ; T₇ -T₃ + Foliar spray – Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%); T₈ -T₂ + Foliar spray - Aloe vera leaf extract(20ppm); T₉ -T₃ + Foliar spray - Aloe vera leaf extract(20ppm); T₁₀ -T₂ + Foliar spray - Moringa leaf extract(20ppm); T₁₁ -T₃ + Foliar spray - Moringa leaf extract(20ppm); T₁₂ -T₂ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%) + Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm); T₁₃ -T₃ + Foliar spray - Amino Acid (20ppm) +Micronutrients (Fe, 1.0%, Zn, 0.5% & B, 0.2%)+ Aloe vera leaf extract (20ppm) + Moringa leaf extract (20ppm)

and yield (0.40% and 2.61 kg ha⁻¹) was found in the treatment FYM + foliar spray of amino acids, micronutrients; moringa and aloe vera leaf extracts (T₁₃) and it was on par with the treatment, STCR-IPNS + foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extracts compared to

control. The improved vegetative growth, seed yield and bolder grains increased the essential oil content and also oil yield. The foliar application also increased the essential oil content by increased enzyme activity and metabolic rate. These findings are in accordance with the findings of Massoud *et al.* (2016), Lal *et al.* (2012) and Sinta *et al.* (2015).

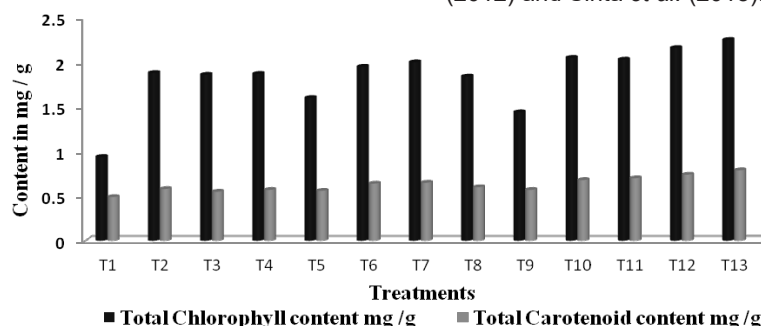


Fig. 1. Effect of IPNS and foliar nutrition on quality parameters of coriander Var. CO (CR) 4

Economics

Economics worked out for the field experiment revealed that application of organic manure and inorganic fertilizers along with foliar spray of different sources had beneficial effect in increasing the net returns and benefit: cost ratio (Table 4). The highest net return of Rs.40433 ha⁻¹ and B: C ratio of 2.71 was recorded in the treatment, FYM + foliar spray of amino acids, micronutrients, moringa and aloe vera leaf extract over other treatments. Organic manure application might have improved the soil properties over a long term and sustained the yield. Foliar application of plant extracts and micronutrients enhanced the economic yield of coriander ultimately resulted in higher net return and benefit cost ratio over other treatments (Lal *et al.* (2012) and Singh (2015)).

Conclusion

Overall, from the experimental results it could be concluded that application of organics on 100 percent N equivalent basis along with foliar spray of amino acids (20 ppm), micronutrients Fe (1%), Zn (0.5%), B (0.2%) moringa leaf extract (20 ppm) and aloe vera leaf extract (20 ppm) spray at critical stages of crop growth (25, 40 and 55 DAS) was found to be optimum for getting higher leaf and seed yield, quality improvement in coriander variety CO(CR) 4 and higher returns per rupee invested in the Alfisols of Tamirabarani command area, Tamil Nadu.

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