Several factors are associated with successful production of coriander. Among them, water and organic manures play strategic role. Continuous attempts have been made to ascertain the proper scheduling of irrigation and organic manures for coriander to increase the yield of coriander growing regions in India and abroad. Attempts have been made here to present a brief summary of research works more or less related to combined effect of irrigation and organic manures on coriander and wherever, felt necessary the research works on other spice crops carried out by eminent scientists at various locations are also given. The review has been summarized under the following sub heads.

2.1 Effect of irrigation

2.2 Effect of organic manures

2.3 Interaction effect of irrigation and organic manures

2.1 Effect of irrigation

Sankat (1993) observed that 1.00 IW/CPE ratio recorded significantly higher seed yield and net realization with net ICBR in coriander.

Field experiment was conducted on loamy sand soils to study the effect of different levels of irrigation (0.6, 0.8 and 1.0 IW/CPE ratios), nitrogen (60, 90 and 120 kg ha$^{-1}$) and phosphorus (30, 45 and 60 kg ha$^{-1}$) on yield and uptake of nutrients by fennel. Amin (2004) revealed that significant increase in seed and stover yields as well as nitrogen and phosphorus uptake by crop were recorded up to 0.80 IW/CPE ratio.

A field experiment was conducted at Sardar Krushinagar on loamy sand soil to study the response of fennel to irrigation and fertility levels. Amin (2005) reported that water use efficiency and water expense efficiency were maximum under 0.8 IW/CPE ratio.
An experiment was carried out during winter seasons of 2001 to 2003 on sandy loam soil at Agricultural Research Station, Sriganganagar to study the effect of nitrogen and irrigation on water use, moisture extraction pattern, nutrient uptake and yield of fennel. Bhunia et al. (2005) found that with an increase in irrigation frequency from IW/CPE ratio 0.4 to 0.8 significantly increased seed yield, gross and net return as well as B:C ratio.

Effect of irrigation on moisture extraction pattern, evapotranspiration and yield of fenugreek was studied by Datta and chatterjee (2006) and they observed that moisture extraction was maximum in 0-15 cm soil depth irrespective of irrigation and decreased with soil depth. Consumptive use of water was maximum when crop was irrigated at 1.0 IW/CPE ratio.

Datta et al. (2006) studied the effect of irrigation levels on growth, yield and evapotranspiration in coriander at Mohanpur, Nadia. They reported that the highest water use efficiency was recorded under no irrigation and the lowest in higher level of irrigation at an IW/CPE ratio of 1.0. The highest seed yield, gross return, net return and benefit: cost ratio were recorded at IW/CPE ratio of 1.0. Irrigating the crop at branching + pre-flowering + seed development stage noted maximum benefit: cost ratio which was closely followed by IW/CPE ratio of 1.0.

An experiment was conducted during rabi seasons of 2001-02 and 2002-03 at the Instructional Farm of the University, Raipur to investigate the effect of irrigation schedule in spice crops grown after medium duration rice. The treatments comprising six irrigation schedule, viz., no irrigation, one irrigation at 35 days after sowing, 2 irrigations at 35 and 75 days after sowing, 3 irrigations at 35, 60 and 85 days after sowing, irrigation schedule at 0.6 and 0.8 IW/CPE ratio were tested on 4 crops, viz., coriander, black cumin, fenugreek and chickpea (check). The results of experiment on effect of irrigation schedule on productivity potential of spice crops revealed that the irrigation schedule at 0.8 IW/CPE ratio gave significantly higher growth characters like, plant height, number of branches, shoot and root dry biomass, seed yields, chickpea equivalent yield, net return and B:C ratio (Lakpale et al., 2007).

A field experiment was conducted on sandy loam soil at New Delhi during the winter season of 2003–2004. Kumar et al. (2008) reported that the application of three irrigations at branching, flowering and seed formation stages gave the maximum
values of growth and yield attributes (plant height and branches plant\(^{-1}\), umbels plant\(^{-1}\), umbellets umbel\(^{-1}\) and seeds umbel\(^{-1}\)) with the highest seed and stover yields in coriander.

An investigation was undertaken at Sriganganagar (Rajasthan) to study the effect of irrigation and nitrogen on water use, moisture extraction pattern, nitrogen uptake and yield of coriander in north-western irrigated plains of Rajasthan from *rabi* 2002-03 to 2004-05. Bhunia *et al.* (2009) reported that significantly maximum plant height, primary and secondary branches plant\(^{-1}\), umbels plant\(^{-1}\), umbellates umbel\(^{-1}\), seeds umbel\(^{-1}\), test weight, seed and stover yields, harvest index, B:C ratio and nitrogen uptake were recorded when crop was irrigated at 0.8 IW/CPE ratio.

A field trial was conducted on medium black soil during *rabi* seasons of 2006-07 and 2007-08 at JAU, Junagadh. Chovatia (2009) revealed that scheduling irrigation at seedling, branching, flowering, pod formation and pod development stages in fenugreek recorded significantly higher number of seeds pods\(^{-1}\), test weight and protein content than scheduling irrigation at seedling, branching, flowering, pod formation and seedling; branching and pod formation stages.

An experiment was carried to study the termination of irrigation in different phenological stages in different land races of coriander. Three irrigation treatments (i.e. I\(_1\)- irrigation terminated at the start of blooming, I\(_2\)- irrigation terminated at the start of flowering and I\(_3\)- irrigation terminated at start of seed formation) and four Iranian land races (Hamadan, Khuzestan, Shiraz and Yazd) were studied. Nadjafi *et al.* (2009) reported that irrigation regimes had no significant effect on yield components but the highest seed yield was observed in I\(_3\) (i.e. irrigation terminated at the start of seed formation).

Tripathi *et al.* (2009) carried out an experiment on sandy loam soil at Morena (MP) during 2006-07 and 2007-08 to study the effect of irrigation schedules and nutrient levels on growth and yield of coriander. They reported that irrigating the coriander at 20, 40 and 60 DAS produced more umbels plant\(^{-1}\), umbellates plant\(^{-1}\), 1000 seed weight, seed yield, biomass production, net return, B:C ratio, production efficiency, nutrient use and; NPK and S uptake.

Mehta *et al.* (2010) undertaken an experiment during *rabi* seasons of 2006-07 and 2007-08 at Sardar Krushinagar to study the effect of irrigation schedules and weed
management practices on fenugreek. They found significantly higher seed, straw, biological yields and net returns with 1.0 IW/CPE ratio over 0.6 and 0.8. While B: C ratio was higher under 0.8 IW/CPE ratio.

A field experiment was conducted at Pali-Marwar to study the response of cumin (*Cuminum cyminum* L.) to variable irrigation through micro-sprinkler, organic manure and nitrogen under semi-arid environment. Irrigation through micro sprinkler at 0.8 IW/CPE ratio being on par with 1.0 IW/CPE ratio recorded significantly the highest plant height (32.5 cm), umbels plant⁻¹ (22.4), seed weight (2.99 g plant⁻¹), dry matter (5.39 g plant⁻¹) and seed yield (678 kg ha⁻¹) of the cumin on pooled basis. The maximum irrigation water productivity was recorded at 0.8 IW/CPE ratio (Rao et al., 2010).

A field trial was carried out during 2003 to 2006 at Ajmer to study the growth, profitability and productivity of fennel as influenced by irrigation, nutrient levels and crop geometry. Mehta *et al.* (2011a) observed significantly higher umbels plant⁻¹, seeds umbellate⁻¹, umbellates umbel⁻¹ and test weight. Significantly higher seed, straw and biological yields; harvest index, gross and net return as well as BCR were obtained with 15 days irrigation interval.

An experiment was carried out to study the effect of salicylic acid levels and irrigation intervals on growth and yield of coriander in field condition during 2011 at the Experimental Farm of Agricultural Faculty, Islamic Azad University, Sanandaj, Iran. Hesami *et al.* (2012) reported that coriander irrigated at 4 days interval produced significantly taller plant, maximum seed yield and plant biomass.

Field study was conducted during *rabi* seasons of 2003-2006 to study the growth, profitability and productivity of fenugreek as influence by irrigation and nutrient levels with varying crop geometry. The maximum seed yield, net return (₹35086 ha⁻¹) and BCR (1.68) in fenugreek obtained with the application of irrigation at 12 days interval (Mehta, *et al.*, 2012).

A study was conducted during *rabi* seasons of 2003-04 to 2005-06 at National Research Centre on Seed Spices, Tabiji, Ajmer (Rajasthan) to study the growth and yield of coriander as influenced by irrigation and nutrient levels with varying crop geometry. Mehta *et al.* (2013a) concluded that plant height was maximum when crop was irrigated at 12 days interval. Significantly higher branches plant⁻¹, dry matter
accumulation plant\(^{-1}\), umbels plant\(^{-1}\), seeds umbel\(^{-1}\), seed and straw yields, biological yield, harvest index, gross and net realization were recorded when crop was irrigated at 15 days interval.

Mehta et al. (2013b) conducted field experiment during *rabi* seasons of 2003 to 2006 to study the effect of irrigation and nutrient levels with varying crop geometry on growth, yield and profitability of ajwain (*Trichospermum ammi*). Three irrigation levels (12, 15 and 18 days interval) in main plot, three nutrient levels (N+P\(_2\)O\(_5\) each of 30 + 15, 40 + 20 and 50 +25 kg ha\(^{-1}\), respectively) and three crop geometries ( 40 x 25, 50 x 25 and 60 x 25 cm ) were assigned in sub plot. They observed that the application of irrigation at 18 days interval gave higher yield attributes *viz.*., umbels plant\(^{-1}\) (184.3), seeds umbellate\(^{-1}\) (17.0), umbellates umbel\(^{-1}\) (17.6) , test weight (2.0 g), seed yield (11.7 q ha\(^{-1}\)), net return (₹21885 ha\(^{-1}\)) and BCR (1.15) over irrigation at 15 and 12 days interval.

An investigation was undertaken at Bangbandhu Sheikh Mujibur Rahman Agricultural University, Gazipur (Bangladesh) from 2000 to 2010 to find out the effect of irrigation on seed yield and yield attributes of coriander. Moniruzzaman et al. (2013) revealed that 3 irrigations (*i.e.* at branching, flowering and seed filling stages) produced significantly higher plant height, primary and secondary branches plant\(^{-1}\), days to bolting, days to 50% flowering, umbels plant\(^{-1}\), umbellates umbel\(^{-1}\), seeds umbel\(^{-1}\), seeds plant\(^{-1}\), seed yield plant\(^{-1}\), 1000 seed weight, seed and stover yields, harvest index, gross and net returns as well as B: C ratio. Total water used was higher under three irrigations. Whereas, water use efficiency and irrigation water use efficiency were maximum with two irrigations.

A field trial was conducted during the *rabi* seasons of 2011 and 2012 at Research Farm, College of Horticulture, Mandsaur (MP) to study the effect of seed treatment and foliar spray of thiourea on growth, yield and quality of coriander under different irrigation levels. Shanu et al. (2013) showed that application of 6 irrigations to coriander crop produced significantly maximum plant height, number of branches plant\(^{-1}\), maximum days to flowering and maturity; fresh and dry weight of leaves plant\(^{-1}\), number of umbels plant\(^{-1}\), umbellates umbel\(^{-1}\), seeds umbel\(^{-1}\), test weight, seed and straw yields, biological yield, net return and B:C ratio.
Review of literature

An experiment was carried out during 2007-08 and 2008-09 to study the impact of different water regimes based on class-A pan on growth, yield and oil content of coriander at Horticulture Department, Faculty of Agriculture, Tanta University, Egypt. Hassan and Ali (2014) revealed that growth, yield attributes and yield were improved with higher irrigation levels compared to lower irrigation levels.

Mehta et al. (2014) at Sardarkrushinagar, Gujarat during 2006-07 and 2007-08 observed that comprising of three irrigation levels (Irrigation water/Cumulative Pan Evaporation Ratio of 0.6, 0.8 and 1.0). The highest consumptive use of water (409.89mm), seed (1474 kg ha⁻¹) and straw yields (2835 kg ha⁻¹); higher water use efficiency (3.94 kg ha⁻¹ mm⁻¹) and water expanse efficiency (3.37 kg ha⁻¹ mm⁻¹) were recorded with 0.8 IW/CPE ratio.

Sharangi and Roychowdhury (2014) conducted a study on coriander at HRS, Mondouri, BCKV, India to determine the effect of phenology and yield of coriander as influenced by sowing dates and irrigation. They observed maximum plant height, number of umbels plant⁻¹, test weight and seed yield when coriander was irrigating at 15 + 30 + 45 + 60 + 75 + 90 + 105 DAS + seed set.

A field experiment was conducted at Bikaner, Rajasthan to study the effect of FYM, foliar feeding of nitrogen and deficit irrigation on drip irrigated coriander. Verma et al. (2015) reported that drip irrigation at 80% ETc + foliar spray of 25% N + fertigation recorded highest plant height, branches plant⁻¹, umbels plant⁻¹, umbellates plant⁻¹, seeds umbel⁻¹, test weight, seed yield, B:C ratio and WUE.

Angeli et al. (2016) carried out an experiment to evaluate the yield components and water use efficiency in coriander under different irrigation depths and N doses. Results showed that maximum seed yield and number of branches plant⁻¹ were recorded when crop was irrigated at a depth of 115% of real requirement of irrigation (RRI), while higher number of leaves plant⁻¹ at 68% of RRI, maximum plant height at 121% of RRI. Maximum WUE was noted when coriander was irrigated at 26% of RRI.

An investigation was undertaken at Udaipur for two consecutive rabri seasons of 2011-12 and 2012-13 with aim to rationalize the water use and enhance the productivity of fenugreek through use of appropriate IW/CPE ratio and fertilizers levels. Dhaker et al. (2016) showed that IW/CPE ratio of 1.0 registered significantly
higher seed yield (1833 kg ha⁻¹), haulm yield (5111 kg ha⁻¹), consumptive use (211.91 mm ha⁻¹), dry matter plant⁻¹ at 40 and 80 days (1.40, 11.97g, respectively) over different lower IW/CPE ratios. IW/CPE ratio of 1.0 noted significantly higher net return of ₹ 58442 ha⁻¹ and benefit cost ratio (3.53) over lower IW/CPE ratios of 0.4, 0.6 and 0.8.

Field study was conducted during rabi season of 2010-11 and 2011-12 at Agronomy Farm, B. A. College of Agriculture, Anand, Gujarat. From the results Sharma, et al., 2016 revealed that the highest WUE (6.61 kg ha⁻¹ mm⁻¹) and significantly higher grain yield (1827 kg ha⁻¹) was recorded when fenugreek was irrigated at 0.6 IW/CPE ratio + 1.0 IW/CPE ratio (I₂) while, maximum moisture content (9.64%) before irrigation and consumptive use (300.28 mm) were observed with irrigation at 0.8 IW/CPE ratio + 1.0 IW/CPE ratio (I₃).

Unlukara et al. (2016) conducted two years field study to determine plant biomass, plant height, seed yield, fatty acid, essential oil contents and essential oil composition of coriander (*Coriandrum sativum* L.) cultivars across different irrigation levels in a semi arid climate area of Kayseri, Turkey. They reported that higher seed and essential oil yields were obtained with elevated water application. Water stress caused decrease in coriander biomass, plant height, seed and essential oil yields. Fatty acid and essential oil ratios were not significantly affected by water stress.

An investigation was carried out at the Horticultural Research Station, BCKV, West Bengal to determine the optimum sowing time and irrigation schedule in fenugreek. The sowing was done in five different dates i.e. 2nd, 9th, 16th, 23rd November and 28th December using three irrigation levels. Bhutia and Sharangi (2017) concluded that to obtain higher seed yield of fenugreek, crop should be sown on 2nd November and irrigation should be given at seedling, branching, flowering, pod formation and pod development stages.

2.2 Effect of organic manures

Jain et al. (2005) studied the response of fennel (*Foeniculum vulgare* Mill) to inorganic nitrogen and farm yard manure at Jobner (Rajasthan). They observed maximum plant height, number of umbels plant⁻¹ and seed yield (1158 kg ha⁻¹) when crop was fertilized with inorganic nitrogen (100 %) + *Azospirillum* @ 1.5 kg ha⁻¹ + 5 t farm yard manure ha⁻¹.
Response of cumin (*Cuminum cyminum*) to inorganic N, farm yard manure (FYM) and bio fertilizers were studied by Choudhary *et al.* (2006) and they observed that the maximum number of branches plant\(^{-1}\) (5.92), umbels plant\(^{-1}\) (21.28), umbellates umbel\(^{-1}\) (5.28), seeds umbel\(^{-1}\) (32.8), test weight (4.50 g), were recorded with the application of inorganic N (100%) + *Azospirillum* @ 1.5 kg ha\(^{-1}\) + 5 t FYM ha\(^{-1}\). They also reported that higher seed (80.4 %) and straw yields (42.8%) over the control and the highest net returns of ₹ 6357 ha\(^{-1}\) and benefit: cost ratio of 1.39:1 when cumin was fertilized with 100% inorganic N + *Azospirillum* @ 1.5 kg ha\(^{-1}\) + 5 t FYM ha\(^{-1}\).

Jat *et al.* (2006) studied the integrated nutrient management in fenugreek (*Trigonella foenum-graecum*) and they revealed that the plant height, branches plant\(^{-1}\), pods plant\(^{-1}\), seeds pod\(^{-1}\), straw yield, N and P uptake by straw were higher when crop was fertilized with 100% inorganic N + *Rhizobium* @ 1.5 kg ha\(^{-1}\) + 5 t FYM ha\(^{-1}\). The highest seed yield, net return, benefit: cost ratio, N and P uptake by seed were recorded under 100% inorganic N alone.

An experiment was carried out at National Research Centre on Seed Spice, Tabiji, Ajmer (Rajasthan) during *rabi* seasons of 2000-01 and 2001-02 to study the influence of nitrogen, *Azospirillum* sp. and farm yard manure on growth, yield and incidence of stem gall disease in coriander. Malhotra *et al.* (2006) showed that plant height, number of primary branches plant\(^{-1}\), number of umbels plant\(^{-1}\), seeds umbel\(^{-1}\). 1000 seed weight and seed yield were significantly higher when crop was fertilized with 100% RDN + FYM @ 5 t ha\(^{-1}\) and seeds were inoculated with *Azospirillum* sp.

The field trial was conducted on Experimental Field at Department of Horticulture, MAU, Parbhani (MS) during *rabi* seasons of 2003 and 2004 to study the effect of spacings and organic manures on growth of coriander. Vasmate *et al.* (2007) found that amongst the different organic manures, application of FYM @ 20 t ha\(^{-1}\) recorded maximum plant height, primary and secondary branches, number of leaves, east-west and south-north spread.

Giridhar and Reddy (2008) studied the effect of FYM on the performance of rainfed coriander in vertisols. Inoculation of microorganisms and FYM @ 5 t ha\(^{-1}\) applied along with recommended dose of inorganic nitrogen @ 100 % N showed significant influence on growth parameters when compared with absolute control.
Plant height, primary and secondary branches and seed yield were significantly higher with FYM @ 5 t ha\(^{-1}\).

An experiment was carried out to study the effect of spacing and organic manures on seed yield of coriander (*Coriandrum sativum* L.) during *rabi* season of 2003-04 at MAU, Parbhani. Vasmate *et al.* (2008) found maximum plant height, number of leaves plant\(^{-1}\), number of umbels plant\(^{-1}\), number of umbellets umbel\(^{-1}\), number of seeds umbellets\(^{-1}\), number of seeds plant\(^{-1}\), seed yield plant\(^{-1}\), seed yield plot\(^{-1}\), seed yield hectare\(^{-1}\), test weight and germination per cent when crop was fertilized with FYM @ 20 tonnes ha\(^{-1}\).

Kumawat and Yadav (2009) studied the response of fenugreek to farm yard manure and phosphorus and they reported that an application of farm yard manure showed the significant increase in seed index, seed yield, straw yield as well as significant increase in nitrogen, phosphorus, potassium, calcium and sodium uptake by seed and straw.

An experiment was undertaken for two subsequent seasons from 2004-05 to 2005-06 at Agriculture Research Station, Durgapura, Jaipur in irrigated coarse textured micro farming situation to test the compatibility of phosphorus and sulphur enriched organic manures in coriander. Results clearly indicated that enrichment of organic manure (FYM and vermicompost) with HGPR, gypsum and bio inoculants recorded higher stover yield and B: C ratio while, nutrient content in soil after harvest of crop were maximum in P and S enriched organic manure (Singh *et al*., 2009).

Adhav *et al.* (2010) studied the influence of organic and inorganic sources of nitrogen on growth and yield of *rabi* drilled fennel during 2007-08 at Navsari. The result revealed that maximum seed yield and yield attributes were recorded when recommended dose (90-45 kg N P\(_2\)O\(_5\) ha\(^{-1}\) of fertilizer applied through inorganic sources. Different organic sources (castor cake, neem cake and bio compost) with inorganic fertilizer in 1:1 ratio gave higher yield than recommended dose of N through inorganic source.

Patel *et al.* (2010) studied the effect of conjunctive use of bio-organic and inorganic fertilizers on growth, yield and economics of *rabi* fennel (*Foeniculum vulgare* Mill.) and they revealed higher and profitable yield of *rabi* fennel with the
application of either castor cake @ 0.5 t ha\(^{-1}\) or neem cake @ 0.5 t ha\(^{-1}\) with 100 \% RDF (i.e. 90:30:00 NPK kg ha\(^{-1}\)) under vertisols of South Gujarat conditions.

Maheta \textit{et al}. (2011b) conducted an experiment to study the influence of varying organic sources of nutrients on growth and yield of coriander at Research Farm of NRCSS, Ajmer during \textit{rabi} seasons of 2003, 2004 and 2005 and they concluded that all organic and inorganic sources of nutrients with and without \textit{Azotobacter} proved superior and exhibited higher yield over absolute control. Application of \textit{Azotobacter} as sole as well as in combination with sheep manure, vermicompost and recommended dose of fertilizer resulted higher growth, yield attributes and yield over absolute control.

An investigation was undertaken during \textit{rabi} seasons of 2004-05 and 2005-06 at Central Institute of Medicinal and Aromatic Plants Research Centre, Bangalore. Singh (2011) reported that the application of vermicompost @ 7.5 t ha\(^{-1}\) + 25\% RDF (i.e. 25-12.5-12.5 kg NPK ha\(^{-1}\)) produced significantly higher plant height, plant spread, biomass yield, seed and oil yields as well as oil content.

Darzi (2012) study the effect of organic manures and biofertilizers application on flowering and some yield traits of coriander (\textit{Coriandrum sativum} L.) and reported that the highest umbels plant\(^{-1}\) and biomass yield were obtained with application of cattle manure @15 t ha\(^{-1}\).

A field experiment was carried out on coriander (\textit{Coriandrum sativum} L.) during \textit{rabi} season of 2005-06 on loam sand soil. Nayak \textit{et al}. (2013) revealed that the application of FYM @ 20 t ha\(^{-1}\) produced significantly higher seed (9.8 q ha\(^{-1}\)) and straw yields; oil yield (1.83 l ha\(^{-1}\)), plant height, dry matter accumulation, number of branches plant\(^{-1}\), number of umbels plant\(^{-1}\) and seed weight plant\(^{-1}\) over control whereas, number of seeds umbel\(^{-1}\) and test weight were not affected significantly due FYM application.

Pariari and Khan (2013) studied the response of organic manures with or without inorganic nitrogen on growth and yield of coriander (\textit{Coriandrum sativum} L.) Total amount of 40 kg N ha\(^{-1}\) was applied through two organic sources of nitrogen \textit{viz.}, cow dung manure and vermicompost in different combinations with or without an inorganic source of nitrogen (urea). The results revealed that vermicompost and urea in 1:1 ratio showed highest increment in plant height (75.50 cm) whereas, lowest
values for the growth parameters were obtained with application of 100% cow dung manure only.

An experiment was conducted during winter seasons of 2004-05 and 2005-06 at College of Agriculture, Morena, Madhya Pradesh to assess the effect of organic and inorganic sources of nutrient on productivity and economics of coriander. Tripathi et al. (2013) reported that application of 50% RDF + FYM @ 5 t ha\(^{-1}\) + PSB @ 2.5 kg ha\(^{-1}\) recorded maximum plant height (125.48 cm), number of primary (15.20) and secondary (34.20) branches plant\(^{-1}\), days to 50% flowering (82.58), number of umbels plant\(^{-1}\) (54.18), umbellates umbel\(^{-1}\) (5.84), grains umbel\(^{-1}\) (5.79), days to maturity (140.25), test weight (13.8g), seed yield (16.8 q ha\(^{-1}\)), net return (₹37280 ha\(^{-1}\)) and B:C ratio (4.38).

Field study was undertaken during rabi season of 2013-14 at Instrumental Farm, College of Agriculture, JAU, Junagadh on medium black calcareous soil. Donga (2014) recorded significantly higher plant height, dry weight plant\(^{-1}\), plant spread, number of branches plant\(^{-1}\), number of umbels plant\(^{-1}\), umbellates umbel\(^{-1}\), seeds umbel\(^{-1}\) and test weight with the application of RDF @ 20:10 kg N: P\(_2\)O\(_5\) ha\(^{-1}\) which remained at par with vermicompost @ 1.0 t ha\(^{-1}\).

Godara et al. (2014) carried out an experiment to study the influence of organic and inorganic sources of fertilizers on growth, yield and economics of coriander at Adaptive Trial Centre, Ajmer during rabi season of 2010-11. They reported that significantly higher seed yield was recorded under 100% RDF through combination of different organic sources over absolute control. Significantly maximum values of growth and yield attributes, grain and stove yields, biological yield, gross and net income along with B: C ratio were observed when crop was fertilized with 100% RDF.

An investigation was undertaken during winter seasons of 2007–08 to 2010–11 (except 2008–09) at Sardar Krushinagar (Gujarat) on loamy sand soil to evaluate the effect of different organic manures and bio-fertilizers on yield, nutrient uptake and economics of fenugreek (Trigonella foenum-graecum L.) under organic farming. Patel et al. (2014) revealed that combined application of 50% RDN through castor cake along with Rhizobium + PSB seed inoculation recorded significant improvement in yield attributes viz., number of pods plant\(^{-1}\), seeds pod\(^{-1}\) and test weight as well as seed.
and stover yields of fenugreek in pooled results. It also proved its superiority with respect to N, P and K content (%) in seed as well as in straw and total N, P and K uptake. Conjunctive use of 50% RDN through castor cake + *Rhizobium* and PSB seed inoculation remarkably improved soil fertility viz., organic carbon, available N, P and K after harvest of fenugreek crop as compared to RDF through inorganic fertilizers and sole application of either organic manures or bio-fertilizers. It also recorded maximum net returns (₹22,859) and benefit: cost ratio (1.65).

A pot experiment was conducted at Islamic Azad University, Tehran, Iran during 2013 to find out the effect vermicompost and manure on yield and yield components of coriander as a medicinal herb. Shakeri *et al.* (2014) observed that application of vermicompost @ 30% volume of pot soil resulted in yield improvement and essential oil content.

Shirkhodaeil *et al.* (2014) conducted an experiment on coriander at Research Field of Agriculture Company of Ran in Firouzkuh of Iran during 2012 and they showed that the highest fresh weight of plant, dry weight of plant and biomass yield were obtained with the application of vermicompost @ 9 t ha⁻¹.

Vasoya (2014) at Junagadh observed that the fennel plants exhibited the maximum values of yield attributes viz., number of umbels plant⁻¹, umbellates umbel⁻¹, seeds umbel⁻¹ and test weight with the application of castor cake @ 1.0 t ha⁻¹ (M₃) and vermicompost @ 1.5 t ha⁻¹ (M₂). The harvest index was failed to manifest significant influence with the application of different levels of organic manure.

Dadiga *et al.* (2015) carried out an experiment during rabi season of 2012-13 at Vegetable Research Farm, Department of Horticulture, JNKVV, Jabalpur (MP) to study the influence of organic and inorganic sources of nutrients on growth, yield attributes, yield and economics of coriander and they concluded that maximum plant height, primary and secondary branches were recorded when crop was fertilized with vermicompost @ 5 t ha⁻¹ + 100 % RDF. While, maximum seed yield was produce when crop was fertilized with poultry manure @ 5 t ha⁻¹ + 100 % RDF.

A field trial conducted to study the effect of vermicompost and nitrogen fixing bacteria on seed yield, yield attributes and essential oil content of coriander at Research Field of Agriculture Company of Ran in Firouzkuh of Iran during 2012. Darzi *et al.* (2015) showed that the highest umbels plant⁻¹, seed yield and essential oil...
content were recorded with the application of vermicompost @ 6 t ha\(^{-1}\). The maximum umbellates umbel\(^{-1}\) and biomass yield were noted with the application of vermicompost @ 3 and 9 t ha\(^{-1}\), respectively.

Field experiment was conducted on medium black calcareous soil of Agronomy Farm, Junagadh Agricultural University, Junagadh during rabi season of 2012–13 to study the effect of varying levels of organic manures and bio- fertilizers on nutrient content and uptake by coriander (*Coriandrum sativum* L.). Donga *et al.* (2015) indicated that the application of recommended dose of fertilizers recorded significantly highest nitrogen, phosphorus and potash content and uptake by seed and straw.

An experiment was conducted at Kumarganj, Faizabad during rabi season of 2011-12 to assess the effect of nutrient supplementation through organic sources on growth, yield and quality of coriander. Kumar *et al.* (2015) showed that the maximum plant height, number of primary and secondary branches, number of umbels, 1000 seed weight and seed yield were recorded with the application of FYM @ 5 t ha\(^{-1}\) + vermicompost @ 3.75 t ha\(^{-1}\).

Field trials were conducted at Experimental Field of Department of Horticulture, Tirhut College of Agriculture, Dholi, RAU, Pusa during 2009-10 to 2011-12 to find out the effect of organic manures on growth, yield and economics of coriander. Singh (2015) revealed that fertilizing the coriander with FYM @ 15 t ha\(^{-1}\) + RDF resulted significant improvement in plant height, number of primary and secondary branches plant\(^{-1}\), number of umbels plant\(^{-1}\), umbellates umbel\(^{-1}\), seeds umbel\(^{-1}\), seed yield, gross and net realizations as well as B:C ratio.

Verma *et al.* (2015) carried out an experiment at College of Agriculture, Swami Keshwanand Rajasthan Agricultural University on coriander to study the water use, nitrogen (N) uptake and economics of coriander (*Coriandrum sativum* L.) under organic enrichment, foliar feeding of N and fertigation. They revealed that the application of FYM @ 10 t ha\(^{-1}\) in addition to recommended nitrogen dose (60 kg ha\(^{-1}\)) gave higher yield attributes *viz.*, branches plant\(^{-1}\), umbels plant\(^{-1}\), seeds umbel\(^{-1}\) and test weight as compared to recommended dose of fertilizers.

An experiment was conducted to evaluate the effect of different organic fertilizer levels on growth and yield of coriander at Sam Higginbottom Institute of Agriculture,
Technology and Sciences, Allahabad. Agarwal et al., (2016) revealed that the T<sub>7</sub>: 50% RDF through VC + 25% RDF through NC + 25% RDF through FYM gave maximum plant height, branches plant<sup>1</sup>, umbels plant<sup>1</sup>, umbellates umbel<sup>1</sup>, seeds umbel<sup>1</sup>, 1000-seed weight and seed yield followed by treatment T<sub>4</sub>: 50% RDF through VC + 50% RDF through NC.

Ravimycin (2016) conducted a study on coriander to determine the effect of vermicompost (VC) and farm yard manure (FYM) on the growth, biochemical and nutrient content of coriander (Coriandrum sativum L.) He reported that the vermicompost application increased all the morphological, pigment, protein and nutrient content of coriander plants.

An experiment was conducted during rabi season of 2015-16 at Horticultural Experimental Farm, College of Horticulture, Mandsaur to study the effect of integrated nutrient management on growth, yield and quality of fennel. Bajya et al. (2017) observed that integrated application of 50% recommended dose of nitrogen (RDN) through vermicompost (VC) + 50% RDN through fertilizers showed higher values of all the growth, yield and quality attributes, viz. plant height, branches plant<sup>1</sup>, fresh weight, dry weight, umbels plant<sup>1</sup>, umbellates umbel<sup>1</sup>, seeds umbel<sup>1</sup>, 1000-seed weight, seed yield, stover yield, biological yield, harvest index, protein and nitrogen content in seed over the 100% RDN through FYM, which closely followed by 50% RDN through FYM + 50% RDN through fertilizers.

An investigation was undertaken during rabi seasons of 2015-16 and 2016-17 at the Experimental Site of the Department of Horticulture, College of Agriculture, OUAT, Bhubaneswar. Jhankar et al. (2017) concluded that soil application of inorganic fertilizers (100% RDF) with biofertilizers (Azotobacter + Azospirillum + PSB) @ 2.5 kg ha<sup>-1</sup> and FYM @ 5 t ha<sup>-1</sup> recorded maximum plant height, number of primary branches plant<sup>1</sup>, number of compound leaves plant<sup>1</sup> and yield followed by the soil application of inorganic fertilizer (75% RDF) + biofertilizers (Azotobacter + Azospirillum + PSB) @ 2.5 kg ha<sup>-1</sup> + FYM @ 5 t ha<sup>-1</sup> with respect to plant height, number of primary branches plant<sup>1</sup> and herbage yield. Maximum net profit of ₹10769 ha<sup>-1</sup> and B: C ratio of 2.09 was noted with the soil application of inorganic fertilizers (100% RDF) + bio-fertilizers (Azotobacter + Azospirillum + PSB) @ 2.5 kg ha<sup>-1</sup> + FYM @ 5 t ha<sup>-1</sup>.
2.3 Interaction effect of irrigation and organic manures

An experiment was carried out at Department of Horticulture, Faculty of Agriculture, Minia University, Egypt to study the effect of irrigation and organic fertilization on fennel. Mohamed and Abdu (2004) reported that fennel irrigated with 3 and 4 irrigations with application of plant compost significantly decreased plant height, branches number, and fruit and oil yields. Whereas, application of chicken manure with 5 or 6 irrigations increase plant height, branches number and fruit and oil yields of fennel.

Ahmad et al. (2011) carried out an experiment at the Agricultural Research Station of Zahak, Zabol, south east of Iran to study the effect of water stress and manure application on yield attributes and oil content in coriander and they reported that when crop was irrigated with application of manure @ 20 t ha$^{-1}$ produced maximum umbellates plant$^{-1}$, seed and biological yields.