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Evaluation of potential cumin growing area in hot arid region of Jaisalmer district

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Abstract

India is the largest producer, consumer and exporter of spices, among these cumin is one of the most important spices. Approximately 70% of the Worlds total cumin seed is produced in India of which a maximum 45.5 % is produced in western Rajasthan. The cultivation of cumin crop is less risky in terms of price fluctuation and affordable in terms of input. Even after introduction of advance production technologies for cumin, still it is largely controlled by edaphic factors. The judicial use of natural resources will not only increase the yield but also reduces the cost of inputs. The study was conducted in Jaisalmer district of western Rajasthan for evaluation of the potential of land resources to support economic and sustainable cumin production. The suitability parameters show that agro-ecological and soil system environment of Jaisalmer district is most suitable for cultivation of cumin seeds. The total geographical area of districts is 38.4 lakh hectares. About 51 per cent area is highly suitable for cumin cultivation. Considering slope, erosion and soil fertility limitation, 13.4 lakh hectares (34.97%) area is most suitable for cumin cultivation. Approximately 6.36 lakh hectare land is suitable for cumin with fertility as one of the limitations. Presently, farmers of Jaisalmer district cultivate cumin in 31300 hectare only (year 2013-14). The study suggested that there is still a lot of scope for expansion of cumin crop in the district. The productivity of cumin crop in Gujarat state (700 kg ha^{-1}) is almost double than Rajasthan (344 kg ha^{-1}). The data from the year 2014-15 indicated that 7.21 % area of cumin cultivation in Rajasthan is being kept under cumin seed cultivation in Jaisalmer district while in its neighboring district Barmer, it is 24 %. If efforts are made to bring about 19.48 lakh hectare areas under cumin seed cultivation of Jaisalmer district with the existing productivity level of 344 kg ha^{-1}, then the districts can produce 681 thousand tons of cumin seeds. The present domestic consumption/demand of cumin seed in India is around 100 thousand tons. If the rest, 581 thousand tons of the produce are exported, then India can earn sumptuous revenue.

Key words : Cumin seed, hot arid climate, productivity, soil suitability.

Introduction

India has an old history of cultivation of spices and takes benefit of being a largest producer, exporter and consumer in the world. There are about 63 spices which are grown in India and out of which 20 have been classified as seed spices. The major seed spices grown in India are cumin, fenugreek, coriander and fennel. Cumin is an important seed spices in India (Fig. 1) and its seeds are largely used as condiments in the form of an essential ingredient in all mixed spices and in curry powder for flavoring, vegetables, pickles, soups etc. It also has medicinal properties and is used in treatment of carminative, stomachic, astringent and in diarrhea. Essential oil and oleoresin from cumin have a good international market. The essential oil quality of cumin grown under different AESR of Rajasthan and Gujarat has been studied by Dubey, *et al.,* 2016 and 2017. India is the single largest producer as well as consumer of cumin in the world, accounting for about 70% of world production. Other important producers of cumin are Syria, Iran and Turkey. The cultivation of cumin crop is less risky in terms price fluctuations, potential returns and can be grown in marginal soils. Cumin could be considered as high return per rupee investment and better productivity system crop (Fig. 1 & 2).

A systematic and scientific appraisal of natural resources especially soils and climate and their database are important pre requisites for augmenting cumin production on a sustainable basis. Soil resource inventory is, therefore, basic for ascertaining the potential and problems of an area, and for rationalizing the use of soils according to their capability (Shyampura and Sehgal, 1995). Since no two soils are alike and have their own potential and/or problems and behave differently through management of

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Fig. 1. A fully grown cumin crop in Jaisalmer District

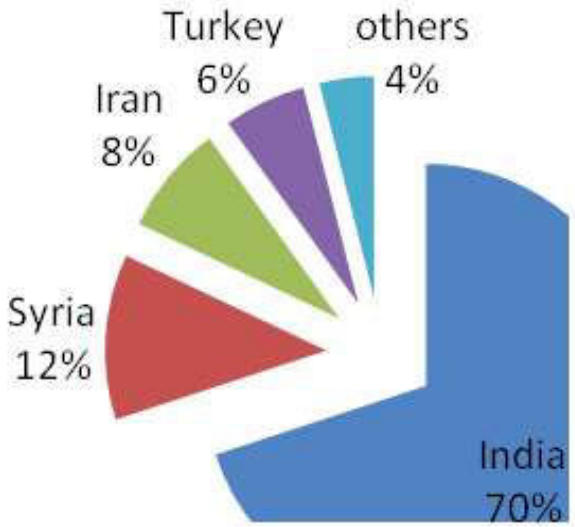

Fig. 2. Share of India in world cumin production

inputs, they can be put to use, as per their capability (Sharma *et al.,* 2010). Physico-chemical characteristics of soils of Western Rajasthan (jaisalmer) were studied on 1: 50, 000 scales by Chaterji and Amal Kar (1992) and Shyampura *et al.,* (2002) but a very little importance was given for scope of seed spices particularly cumin seed production. Aishwath *et al*., (2011) studied to the soils of four districts comprising Ajmer, Bhilwara, Pali and Rajsamand using a GIS approach for potential soil suitability for cumin, coriander, fennel and fenugreek and found that most of the soils were marginally suitable whereas only two per cent area was moderately suitable for coriander production. Present and future prospectus of coriander seed production was studied by Sharma *et al*., (2014) for southeast Rajasthan. The criteria of soil slope, erosion, depth, texture, available water content and length of growing period (LGP) was applied for final assessment of soil suitability. Cultivation of cumin crop needs very specific soil and climatic conditions for its better quality seed production. Both soil and climatic suitability have not been assessed in Indian continent in general and Rajasthan in particular. Therefore, keeping this in view the soil resources of western Rajasthan in particular Jaisalmer district was assessed for future scope of economic and sustainable cumin seed production. This assessment will not only maximizes the production but also reduces the cost of cultivation creating better opportunities for doubling farmers income with little investement.

Data Base and Methodology

Soil suitability criteria for cumin production

Soil survey reports of ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, Udaipur stated that soil quality and climatic suitability of Jodhpur, Barmer, Jaisalmer, Pali, Nagore and Sirohi districts of Rajasthan might be one of the reasons for involvement of the cumin crop in cropping systems. Jain *et al*., (2007) developed a soil suitability criteria (Table 1) for cumin production that include soil depth, slope, texture, erosion, available water content (AWC) and length of growing period (LGP). The limitations considered for assessment of soils are climatic, topographic, wetness, salinity and alkalinity, soil fertility and physical limitation. Cumin can be best cultivated in well drained, coarse loamy or loamy textured soil. Fertile soils with cloud free sunny environment are conducive for its growth. Cumin thrives well between 9 to 26 ^{o}C and annual rainfall of ~270 mm. Cumin is the winter season crop, grows abundantly in the mild, equable climate. These conditions exist in Jaisalmer region which very much suits for cumin cultivation.

The crop can be grown well in soils having pH in the range of 6.5 to 8.5. However, for higher productivity of the crop and quality seed production, it is suggested that pH should be in the range of 6.5-7.5 with more than /or equal to 0.6 percent organic carbon and less than 10 percent calcium carbonate content (Sharma *et al.,* 2010). The essential plant nutrients should be applied through fertilizers and organic manures as per the prescription for agro-ecological/ agro-climatic zones of India. Cumin can tolerate even moderate salinity. Cumin can be grown in soils where electrical conductivity of saturation extract (ECe) is <4.0 dSm^{-1} and exchangeable sodium percentage (ESP) <10.0. However, for ideal conditions soils should have EC and ESP less than 2 dSm^{-1} and 5, respectively. The soil types of Jaisalmer are listed in table 2.

Table 1. Soil suitability criteria for cumin cultivation (Jain *et al*., 2007)

Characteristics	S1- Highly suitable	S2-Moderately suitable	S3-Marginally suitable	N- Not suitable
Climate				
LGP(days	105-120	90-105	<90	<90
Precipitation(mm)	250	150-250	100-150	<100
Mean temp. of growing cycle(o_C)	13-22	10-13	5-10	<5
Topography				
Slope (%)	<1	1-3	3-8	>8
erosion	Slight	Moderate	Severe	Very severe
Coarse fragment	<15	15-35	35-55	>55
Wetness				
Drainage	Well	Well	Moderately well drained	Permeable
Flooding	No	No	<5 cm water for 2-3 days	<5 cm water for 3-7 days
Physical condition of soil				
Depth(cm)	>50	20-50	25-50	<25
Texture	Loam, silty clay loam, clay loam	Fine sand,fine loamy	Sand,Clay	Massive clay, coarse sand
AWC(mm)	>75	50-75	50-75	<50
Fertility of soils				
pH	6.5-7.5	7.5-8.0	8.0-8.5	>8.5
OC(%)	0.6	0.4-0.6	0.4	<0.4
$CaCO_3$(%)	<10	<10	10-20	>20
Salinity-EC(dSm^{-1})	<2	2-4	2-4	>4
Alkalinity-ESP	<5	<5	5-10	>10

Package of practices for Cumin Production

Cumin varieties recommended for cultivation in Western Rajasthan are GC-1, GC-2, GC-3, GC-4, RZ-19, RZ-209, RZ-345 and RZ-223. Crop duration is 110-120 days depending on the variety. Unlike other tropical plants, it requires relatively less irrigation water (218 mm) (Rao *et al*., 2010), and rainfall during the harvesting period is unfavorable for the seed quality, hence under optimum conditions, it requires 90-120 days LGP (Length of Growing Period). The production of cumin seeds is regulated by most limiting factor. Generally, 2 to 5 irrigations are mandatory for cumin crop, depending on the type of soils and average annual rainfall. Under normal agro-climatic conditions a light irrigation is given soon after sowing and there after second irrigation should be applied 8–10 days after first irrigation. Depending upon the soil type and climatic conditions the subsequent irrigations may be given at 15–25 intervals. Last heavy irrigation must be given at the time of seed formation. Avoid irrigation at the time of active seed filling because it increases the incidence of powdery mildew, blight and aphid infestation (Department Agriculture, Govt. of Rajasthan, 2014 & Rao *et al*., 2010).

Presently the area under cumin crop is increasing rapidly since last five year (Table 3). Cumin crop is sown at about one cm depth and requires less water for its life cycle, and also the evapo-transpiration during cumin growth period is very less. The most favourable factor is low relative humidity of the area that prevent the crop from prominent diseases like powdery mildew and downy mildew. The sprinkler system of irrigation is best fitted in the undulating topography of the area for cumin cultivation. All above production factors contribute significantly for cumin cultivation, horizontally as well as vertically for hot arid region.

Results and discussion

Soil Suitability of Jaisalmer District

Considering the increasing demand of cumin seeds in International market the mind setup of the farmers of western Rajasthan especially in Jaisalmer districts should be intensified by transferring the latest agro-technology in relation to cumin seed production. Such interventions not only increase area under this crop but also augment productivity and seed quality for international trade purpose. The suitability study conducted to examine the

Table 2. Major soil types of Jaisalmer district and their characteristics.

Major soil type	Major characteristics	Limitations	Percent area
1. Coarse textured sandy soils of duny complex			
a) Dunes and interdunes	Very deep, very fine, calcareous aeoiian sands, single grained	Highly susceptible to wind erosion; poor moisture retention; rolling topography; very deep rooting zone	43.04
b) Very deep soils of sandy plain (Madasar,Shergarh,Thar, Dabla,Bhojka,Sam,Mayajlar,Par ewar, Chirai series)	Very fine sand to loamy fine sand in sub soil ; very deep with slight to highly hummocky phases; very weak structured	Highly susceptible to wind erosion; poor moisture retention; often hummocky relief; very deep rooting zone	18.18
c) Moderately deep soils of sandy plains (Sodakor, Rajgarh, Kolu, Ghotaru, Chacha series).	Same as above	Same as above, but underlain by moderate to well developed lime kankar zone within 40-70 cm depth; limited rooting zone	12.84
2. Moderately coarse textured soils			
a) Deep to very deep (Lawan, Lakha, Ajasar Nedai series)	Very deep loamy sand to sandy loam; often with slight to moderate hummocky phases	Susceptible to wind deposition; slightly better moisture retention	3.59
b) Moderately deep soils (Bida. Sankra, Nedai, Rajgarh series), Ajasar Lakha, Lawan, Bhojka and Rajgarh varient	Moderately deep soils of loamy sand with sandy loam at subsoil underlain by hard strata	Root zone limitation; low moisture retention; susceptible to wind deposition	6.94
3. Medium to moderately fine textured soils (Sanu Marwa, Devikot, Ram-devra, Bhadasar series)	Moderately deep to deep soils of loam to clay loam texture in subsoil underlain by hard strata	Better water retention; not susceptible to wind erosion, but often sand deposit on surface	5.32
4. Deep soils of 'Khadin' area	Deep alluvial soils of local sediments medium to moderately fine textured	Good for ensured rainfed cropping	0.74
5. Shallow gravelly, rocky soils of piedmont zones	Very shallow gravelly soils with variable lithology and texture	Poor water retention; undulating to sloping land; gravels and stones strewn on surface	3.13
6. Salt affected soils	Very deep moderately fine textured stratified soils of low depressions and Ranns	High salinity; some times inundated; barren	0.52
7. Soils of rocky hills and plateaus	Rocky, sloping areas with pockets of shallow skeletal soils	Exposed rocky surface; high runoff potential	5.71

Table 3. Area and production of cumin in Jaisalmer Districts (000 Hectare Tonnes^{-1})

Year	Area	Production
2009-10	10.33	3.51
2010-11	16.12	8.25
2011-12	23.66	8.84
2012-13	29.74	6.58
2013-14	31.30	11.02

Source: Agricultural Statistics, Department of Economics and Statistics, Govt. of Rajasthan 2016.

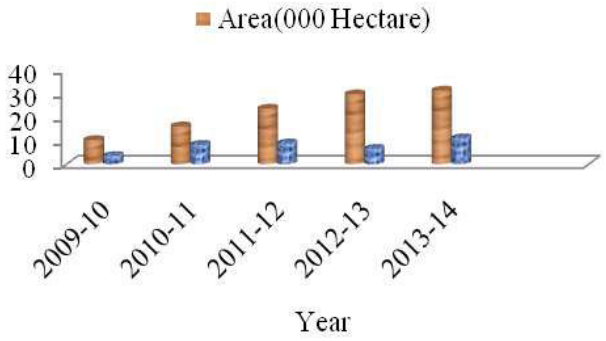

Fig. 2. Area and production of cumin in Jaisalmer district

(Source : Agricultural Statistics, Department of Economics and Statistics, Govt of Rajasthan)

potentials and constraints for cumin production in western Rajasthan based upon erosion; slope, water retention, soil depth, texture and length of growing period (LGP) reveals that out of 38.4 lakh hectares in Jaisalmer district, 49.27 per cent area is not suitable to cultivation due to sand sitting, single grained and loose structure, wind erosion, rocky or hilly landforms, sand dunes and salinity problems. Considering the slope, erosion and soil fertility limitation 13.4 lakh hectares (34.97 %) area is suitable for cumin cultivation. Approximately 6.36 lakh hectare land is suitable for cumin keeping fertility as one of the limitations (Table 1). The study suggested that there is still a lot of scope to acquire the area in the district for cumin crop. Statistics for the year 2014-15 indicated that Jaisalmer (7.21%) and Barmer (24%) district occupied about 1/3 area of Rajasthan for cumin cultivation (Department of Agriculture, Govt. of Rajasthan).

Conclusion

Soils in hot arid region of Rajasthan with various agro-climatic limitations can be best utilized as a potential source of cumin seed production and employment generation. The soil suitability studies of Jaisalmer shows ample scope for expanding cumin cultivation in this district and site suitable package of practices advocated by the research organizations can further boost cumin production and productivity resulting into increase in farmers income and economy of the country. There is vast scope for earning foreign exchange by export of good quality cumin seeds and value added products. There are possibilities due to availability of technologies of cumin seed based cropping systems to increase productivity/income per unit area. The suitable climatic setup is a boon for this region with low use of insecticide and fertilizers, offering good scope for organic cumin seed cultivation.

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