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Incidence of termites in *Bt* cotton in relation to weather parameters

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Abstract
The activity of termite in *Bt* cotton commenced from 2nd week of August [32nd standard meteorological week (SMW)] and continued till 4th week of December (51st SMW). During 2nd to 4th week of August (32nd to 34th SMW), the termite activity was found negligible (2.8 to 7.2 termites/stick) in the field, when crop age was four weeks. The termite activity was found 12.6 to 28/stick during September (35th to 39th SMW). The population continuously increased every week. It was between 28.6 and 50.2 per stick in October (40th to 43rd SMW). The peak incidence was noticed during the end of November (47th SMW). The pest activity was found higher in cotton field during first week of October (40th SMW) to the last week of November (47th SMW). The activity of this pest was started to reduce from 1st week of December. The evaporation and soil temperature (afternoon) at 10 cm depth was highly significant and positively correlated with termite incidence, whereas morning relative humidity had highly significant negative association with population. The wind speed, maximum and minimum temperature, soil temperature at 5 cm, 10 cm and 15 cm depth at morning hours and soil temperature at 5 cm and 15 cm depth during afternoon hours had significantly positive relationship with termite incidence in cotton.

Keywords: Termite, *Bt* cotton, weather parameters

Introduction
Cotton is a soft, fluffy staple fiber that grows in a boll, or protective case, around the seeds of the cotton plants of the genus *Gossypium* in the family of Malvaceae. Cotton, the king of fibre reside one of the momentous and important cash crop that exercising profound influence on economics and social affairs of the world. The word "cotton" derived from the Arabic word "*al qatan*" and popularly known as "White Gold". Cotton is one of the oldest fibre known to mankind [1].

Under natural conditions, the cotton bolls will tend to increase the dispersal of the seeds. The plant is a shrub native to tropical and subtropical regions around the world, including the America, Africa and India. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa. The fiber is most often spun into yarn or thread and used to make soft, breathable textile. The use of cotton for fabric is known to date to prehistoric times, fragments of cotton fabric dated from 5000 BC have been excavated in Mexico and between 6000 BC and 5000 BC in the Indus Valley Civilization. Although cultivated since antiquity, it was the invention of the cotton gin that lowered the cost of production and led to its widespread use, and it is the most widely used natural fiber cloth in clothing today [1].

The commercial cotton is grown in 77 countries and 123 countries are involved in the cotton related activities. Among 123 countries, 38 countries are the major cotton producers as well as major consumers, 30 countries are major raw cotton exporters, while 25 countries exclusively import cotton. Australia, Brazil and China are the world leaders in cotton productivity. The area under cotton cultivation in the world is about 33.4 million hectares with production of 121.4 million bales [2].

As per India's cotton scenario for decades, India established as the leading country in terms of area under cotton in the world. As per USDA estimate, India surpassed the United States in the year 2006 and China in the year 2015 in raw cotton production. India was leading in raw cotton production in the world during 2017-18 and production was up to 37.0 million bales of 480 lb from 12.4 million hectares with a productivity of 505.46 kg/ha. The average area under cotton was only 80 lakh ha during the year 1960 to 2006, but it was gradually increased and reached up to 110 lakh ha during the last decade.

The average cotton production, between the year 1960 and 2006 was just 98 lakh bales (170 kg/bale), while it covered around 320 lakh bales in the last 10 years. The large scale adoption of *Bt* cotton along with improved production and protection technologies took place since 2002, made India as the second largest exporter of raw cotton. Gujarat, Maharashtra and Telangana reside the major cotton growing states contributing around 70 per cent of the area and 67 per cent of cotton production in India. Gujarat ranks second in area (26.23 lakh hectare) and first in production (104.00 lakh bales of 170 kg) in the country. The productivity of cotton in the Gujarat (674.04 kg/ha) is higher than the national average (505.46 kg/ha) [2].

The cotton production remained stagnant over the years due to biotic and abiotic constraints. Among the biotic threats, insect pests being major in India. The insect pest's spectrum of cotton is quite complex and as many as 1326 species of insect pests have been reported on this crop throughout the world of which about 130 different species of insects and mites found to devour cotton at different stages of crop growth in India [3].

Among the various pests attacking the crop, aphid (*Aphis gossypii* Grover), leaf hopper (*Amrasca biguttula biguttula* Ishida), thrips (*Thrips tabaci* Lindeman and *Scirtothrips dorsalis* Hood), whitefly [*Bemisia tabaci* (Gennadius)], mealy bug (*Phenacoccus solenopsis* Tinsley), stem weevil [*Pempherulus affinis* (Faust)], spotted bollworms [*Earias insulana* (Boisduval) and *E. vitella* (Fabricius)], pink bollworm [*Pectinophora gossypiella* (Saunders)], American bollworm or gram pod borer [*Helicoverpa armigera* (Hubner)], red bollworm (*Rabila frontalis* Walker), red cotton bug [*Dysdercus cingulatus* (Fabricius)], dusky cotton bug [*Oxycarenus hyalinipennis* (Costa)], budworm [*Phycita infusella* (Meyrick)], shoot weevil [*Alcidodes affaber* (Auriv.)], ash weevil (*Myllocerus undecimpustulatus maculosus* Desbr.), leaf roller (*Syllepta derogata* Fabricius), semiloopers [*Anomis flava* (Fabricius), *Pardoxia graellsi* (Feisthamel) and *Tarache nitidula* (Fabricius)], *Spodoptera litura* (Fabricius) and termite [*Odontotermes obesus* (Rambur) and *Microtermes obesi* (Holmgren)] were found damaging to cotton crops. Of these termites is an important and destructive pest of cotton in sandy loamy soil [3].

Termites are most primitive social insects in the animal kingdom in order Isoptera. Whitish soft-bodied and ant like social insect that feeds on wood. Of the 300 species of termites, about 35 species have been reported damaging agricultural crops and buildings structures not only in India but also throughout tropical and sub-tropical regions of the world. The termite present in a colony consists of several castes viz., workers, soldiers, reproductive queen and king. Termites having incomplete metamorphosis with three stages *viz.*, egg, nymph and adult. There are two types of reproductive system in termites, primary reproductive and secondary reproductive. As regard habitats, there are two kinds of termites *i.e.* wood dwellers (damp wood and drywood termites) and ground dwellers (subterranean, mound builder and carton nest builder). Termites possess an enlarged sac in the hindgut which contains cellulase secreting flagellate protozoans help in digestion of cellulose of the plant materials. Termites damage the seedlings by either cut just below or above the soil surface. In mature plant, feeding root system and inside the stems, which directly kills the plant or indirectly lowers yield through decreased translocation of water and nutrients. Severally infested plant wilt, dry up and can be easily pulled up. It inflicts heavy damage to the crop cultivated in sandy loam soil, damage the crops right from sowing till harvest. Infestation is particularly serious in dry season. Problem is more predominant in rainfed areas than irrigated [4].

The major mound-building species in India are *Odontotermes obesus*, *O. redemanni* and *O. wallonensis* and the subterranean species are *Heterotermes indicola*, *Coptotermes ceylonicus*, *C. horni*, *Microtermes obesi*, *Trinervitermes biformis* and *M. beesoni*. The most important species attacking cotton were *Microtermes obesi* and *Odontotermes obesus* (Roonwal, 1981) [5].

Materials and Methods

In order to study the incidence of termites in *Bt* cotton in relation to weather parameters, a field experiment was conducted at Entomology farm, B. A. College of Agriculture, Anand Agricultural University, Anand during the *kharif* 2018. Cotton variety (RCH II, Boll Guard II) was sown during 24th July, 2018 in an area of 25 m x 20 m (500 m^2) with a spacing of 120 cm between two rows and 30 cm within the rows.

To record the termite population in field, 25 eucalyptus wooden sticks (about 5 cm diameter, 1 m length) were installed after 15 days of sowing at the depth of 15 cm. The termite counts were recorded by observing each wooden stick at weekly interval and again reinstalled the sticks and this continued till the harvest of the crop. If, whole wooden sticks eaten by termites, the new sticks were installed. The termite population was correlated with meteorological parameters to know the role of abiotic factors on termite fluctuation.

Results and Discussion

The periodical data (Table 1) on termite incidence indicated that the activity of termite was found throughout the cropping season in cotton except 1st week of germination (31ST SMW). The activity of termite was commenced from 2nd week of August (32nd SMW) and continued till 4th week of December (51st SMW). The incidence of termite ranged from 2.8 to 74.2 per stick during crop period. During 2nd to 4th week of August (32nd to 34th SMW), the termite activity was found negligible (2.8 to 7.2 termites/stick) in the field, when crop age was four weeks. The termite activity was found 12.6 to 28/stick in September (35th to 39th SMW). During this period, meteorological parameters like evaporation, bright sunshine hours, wind speed, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, morning vapour pressure, evening vapour pressure, soil temperature at 5 cm, 10 cm and 15 cm depth during morning and afternoon time were 1.9 to 3.2 mm/day, 4.8 to 9.7 hrs, 2.8 to 1.7 kmhr^{-1}, 30.2 to 34 ^{0}C, 19 to 18 ^{0}C, 71 to 34%, 95 to 90%, 22 to 22.5 mm of Hg, 22.3 to 17.1 mm of Hg, 25 to 24 ^{0}C, 27 to 28 ^{0}C, 29.5 to 31.5 ^{0}C, 34 to 44 ^{0}C, 30.5 to 40 ^{0}C, 28 to 35 ^{0}C, respectively. The population continuously increased every week. Similarly, it was between 28.6 and 50.2 per stick in October (40th to 43rd SMW). The evaporation, bright sunshine hours, wind speed, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, morning vapour pressure, evening vapour pressure, soil temperature at 5 cm, 10 cm and 15 cm depth during morning and afternoon time were 3.4 to 4.6 mm/day, 9.5 to 8.7 hrs, 2 to 3.8 kmhr^{-1}, 32 to 37 ^{0}C, 20 to 19 ^{0}C, 43 to 26%, 90 to 83%, 23.1 to 16.8 mm of Hg, 21.6 to 13.4 mm of Hg, 24.5 to 25.5 ^{0}C, 26.5 to 29 ^{0}C, 27.5 to 32.5 ^{0}C, 41 to 44 ^{0}C, 37 to 38 ^{0}C, and 34.5 to 35 ^{0}C,

respectively were recorded during this period. In this month also the pest activity was increased every week. Again same way it was in increasing trend in month of November (44th to 47th SMW) and reached to peak (74.2 termites/stick) on last week of November (Fig. 1). During this period, meteorological parameters *viz.*, evaporation, bright sunshine hours, wind speed, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, morning vapour pressure, evening vapour pressure, soil temperature at 5 cm, 10 cm and 15 cm depth during morning and afternoon time were 3.5 to 4.5 mm/day, 9.4 to 7.1 hrs, 2.9 to 4.5 kmhr^{-1}, 36.5 to 36 ^{0}C, 20.5 to 22.5 ^{0}C, 28 to 39%, 92 to 93%, 18.4 to 23 mm of Hg, 13.6 to 22.5 mm of Hg, 25.7 to 26 ^{0}C, 29 to 27.5 ^{0}C, 32.5 to 30.5 ^{0}C, 43.5 to 43 ^{0}C, 40 to 41 ^{0}C and 36 to 38 ^{0}C, respectively. The activity of this pest was started to reduce from 1st week of December. Even though, at the time of last picking and removal of crop, it was 40.2 termites/stick. The meteorological parameters like evaporation, bright sunshine hours, wind speed, maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, morning vapour pressure, evening vapour pressure, soil temperature at 5 cm, 10 cm and 15 cm depth during morning and afternoon were 4.1 to 1.7 mm/day, 7.4 to 8.9 hrs, 4.2 to 1.9 kmhr^{-1}, 37.5 to 19.9 ^{0}C, 23.8 to 13.5 ^{0}C, 29 to 21.4%, 78 to 52.1%, 25 to 8.8 mm of Hg, 24.5 to 9.9 mm of Hg, 27.5 to 14.5 ^{0}C, 29 to 15 ^{0}C, 32 to 16.9 ^{0}C, 44.5 to 23.6 ^{0}C, 42 to 20 ^{0}C and 39 to 17.9 ^{0}C, respectively were noticed during the period. The population of termite workers and pseudo workers were high during October-February in cotton and groundnut fields (Sen Sarma, 1986) [6]. Akhtar and Shahid (1989) while studying the population dynamics of *Macrotermes mycophagus*, *M. obesi*, *M. unicolor* and *Eramotermes paradoxalis*, reported that high population density of termites in October in cotton fields [7]. Sunitha *et al.* (2011) mentioned that high population of termite *O. obesus* during June-October [8]. The termite population was higher in October to 1st week of November in groundnut with peak level on 2nd week of October in *kharif* (Gohel, 2013) [9]. These reports are in accordance with the present conclusion.

Table 1: Population fluctuation of termites in *Bt* cotton in relation to abiotic factors

Std. week	Month and week	No. of termites/ stick/week	Abiotic factors														
			Evaporation (mm/ day)	Bright sun shine (hrs)	Wind speed (kmph)	Temperature (^{0}C)		Relative humidity (%)		Vapour pressure (mm)		Soil temperature (^{0}C) at depth					
												Morning			Evening		
						Max	Min	Morning	evening	Morning	Evening	5 cm	10 cm	15 cm	5 cm	10 cm	15 cm
31	Aug I	00	3.0	6.1	2.2	32	19	80	85	19	18.5	21	22	25	36	33	35
32	Aug II	2.8	3.4	6.1	2.1	34	20.2	81	87	18.5	18	22	24	25	38.2	35.5	34.5
33	Aug III	5.4	1	5.6	3.3	29.5	21	85	98	21	22.5	20	21	25	33	32	30
34	Aug IV	7.2	2.6	3.1	3.1	31	17	92	100	25.2	27.1	21	22	24	33	30	26
35	Sept I	12.6	1.9	4.8	2.8	30.2	19	71	95	22	22.3	25	27	29.5	34	30.5	28
36	Sept II	18.4	1.7	8.7	3.3	29	18	75	92	23.9	23.2	22	23	25	32.5	30	28.5
37	Sept III	20.2	4.5	8.8	2.9	34	19	62	85	19	20.5	23	23.4	24	39.5	33	31
38	Sept IV	24.2	4	9.2	2.1	32	22	72	100	26.4	27.1	21	22.5	24.5	33.5	31.5	30
39	Sept V	28	3.2	9.7	1.7	34	18	34	90	22.5	17.1	24	28	31.5	44	40	35
40	Oct I	28.6	3.4	9.5	2	32	20	43	90	23.1	21.6	24.5	26.5	27.5	41	37	35
41	Oct II	34.6	3.4	8.8	4.2	33	17.2	33	91	20.4	17.6	25	27	30	40	35	34.5
42	Oct III	42	3.3	9.8	2.9	37.4	20	28	89	19.4	14.7	27	30.5	33	43	39	38
43	Oct IV	50.2	4.6	8.7	3.8	37	19	26	83	16.8	13.4	25.5	29	32.5	44	38	35
44	Nov I	55.6	3.5	9.4	2.9	36.5	20.5	28	92	18.4	13.6	25.7	29	32.5	43.5	40	36
45	Nov II	60.8	3.5	8.7	3.5	35	21	34	90	15	16	23	26.5	30	41.5	38	35
46	Nov III	68.4	4.1	8.3	2.9	34	23	41	89	19	22	25	25.5	29.5	41	39.5	36
47	Nov IV	74.2	4.5	7.1	4.5	36	22.5	39	93	23	22.5	26	27.5	30.5	43	41	38
48	Dec I	74	4.1	7.4	4.2	37.5	23.8	29	78	25	24.5	27.5	29	32	44.5	42	39
49	Dec II	62.2	3.9	8.4	3.3	34.3	22	32	85	14.3	15.7	25	27.3	30.6	42.6	39	35
50	Dec III	58.6	3.3	8.6	2.6	34.5	19.4	35	88	13.8	15.3	22.6	26.1	29.6	40.9	35	33
51	Dec IV	40.2	1.7	8.9	1.9	19.9	13.5	21.4	52.1	8.8	9.9	14.5	15	16.9	23.6	20	17.9

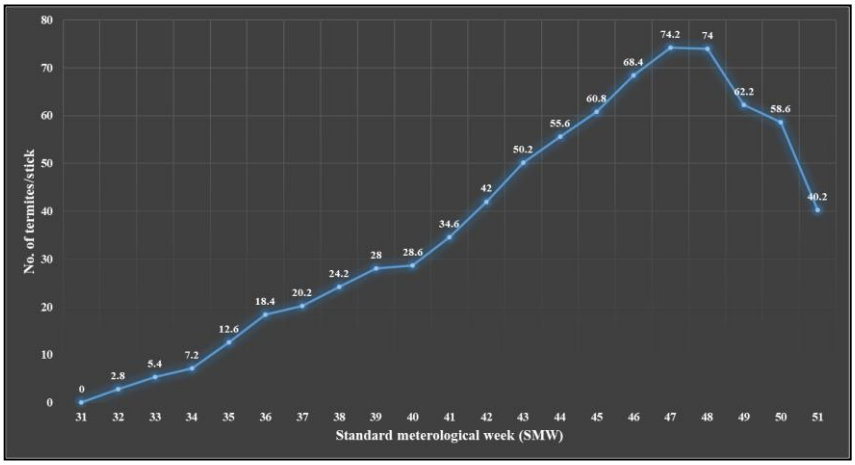

Fig 1: Population abundance of termite in cotton

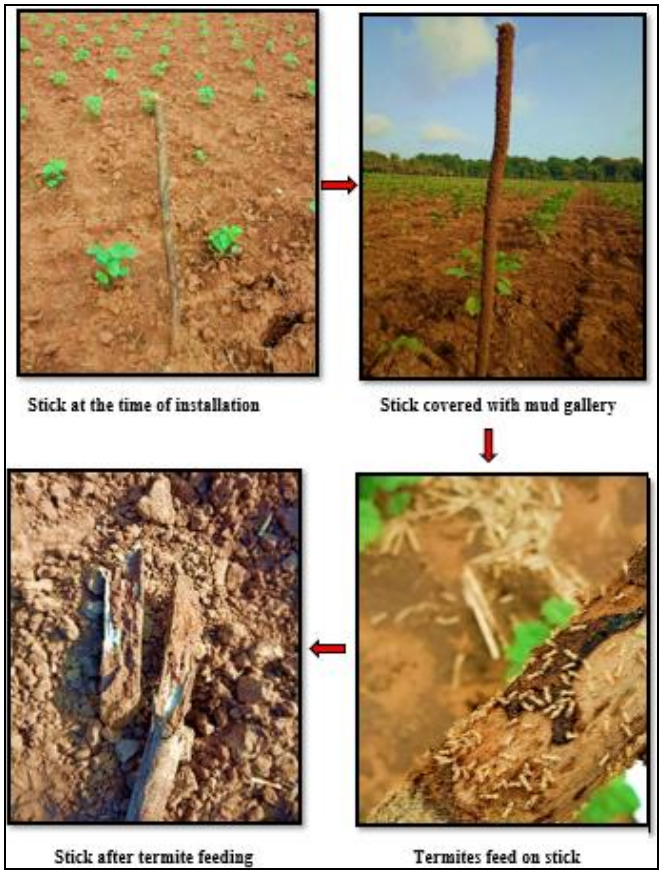

Plate 1: Termites on eucalyptus stick installed in cotton

Correlation co-efficient analysis (Table 2) between termite population and weather parameters in cotton indicated that the evaporation (r=0.572**) and soil temperature (afternoon) at 10 cm depth (r=0.567**) were highly significant and positively correlated with termite populations, whereas morning relative humidity (r=-0.794**) had highly significant negative association with population. The wind speed (r=0.451*), maximum (r=0.445*) and minimum temperature (r=0.464*), soil temperature at 5 cm (r=0.458*), 10 cm (r=0.457*) and 15 cm (r=0.537*) depth at morning hours, soil temperature at 5 cm (r=0.558*) and 15 cm depth (r=0.519*) during afternoon hours had significantly positive relationship with termite incidence in cotton. Morning vapour pressure (r=-0.305) and evening vapour pressure (r=-0.302) had negative, whereas bright sunshine hours (r=0.418) had positive association with the occurrence of termite in cotton. Bhanot *et al.* (1984) reported that the termite population was positively correlated with maximum and minimum temperature in barley [10]. The correlations of termite population with temperature (r = 0.666) was positive and significant, whereas negative with relative humidity (Panhwar, 2009) [11]. Sattar *et al.* (2012) mentioned that atmospheric temperature and precipitation had significantly positive whereas relative humidity had significantly negative correlation with termite activity [12]. Gadhiya (2012) reported that the evaporation and soil temperature (afternoon) at 10 cm depth were highly significant and positively correlated with termite in wheat, whereas morning relative humidity had highly significant negative association with population [13]. The evaporation, minimum and maximum temperature, soil temperature at 5 cm, 10 cm, and 15 cm depth at afternoon hours and soil temperature at 15 cm depth at morning hours had significantly positive relationship with termite activity in groundnut (Gohel, 2013) [9]. Thus, the present finding is agreement with the earlier reports.

Table 2: Correlation coefficient between termite population and abiotic factors in cotton

Sr. No.	Weather parameters	Correlation coefficient ( )
1.	Evaporation (mm/day)	0.572**
2.	Bright Sunshine Hours, hrday^{-1} (BSS)	0.418
3.	Wind Speed, kmhr^{-1} (WS)	0.451*
4.	Maximum Temperature, ^{0}C (Max. T)	0.445*
5.	Minimum Temperature, ^{0}C (Min. T)	0.464*
6.	Morning Relative Humidity, % (RH1)	-0.794**
7.	Evening Relative Humidity, % (RH2)	-0.292
8.	Morning Vapour Pressure, mm of Hg (VP1)	-0.305
9.	Evening Vapour Pressure, mm of Hg (VP2)	-0.302
10.	Soil Temperature, ^{0}C (5 cm depth Morning)	0.458*
11.	Soil Temperature, ^{0}C (10 cm depth Morning)	0.457*
12.	Soil Temperature, ^{0}C (15 cm depth Morning)	0.537*
13.	Soil Temperature, ^{0}C (5 cm depth Afternoon)	0.558*
14.	Soil Temperature, ^{0}C (10 cm depth Afternoon)	0.567**
15.	Soil Temperature, ^{0}C (15 cm depth Afternoon)	0.519*

** Correlation is significant at the 0.01 level * Correlation is significant at the 0.05 level

Reference

1. Reddy SR. Agronomy of field crops Edn 2, Kalyani publishers New Delhi. 2002, 132-178
2. Amar Singh. Indian cotton scenario 2018-19. Edn 41, Cotton Association of India, Mumbai, 2019, 2-8.
3. David BV, Ramamurthy VV. Elements of economic entomology. Edn. 8, Brillion publishing, New Delhi, 2017, 200-253
4. Chapman RF. The insects structure and function. Edn. 5, Cambridge University Press, New York, 2012, 128-135
5. Roonwal ML. Termite injuring crops, plantations and fruit and forest trees and their control. In termite life and termite control. Scientific Publication, Jodhpur. 1981, 24.
6. Sen Sarma. Economically important termites and their management in the Oriental region. Economic impact and control of social insects. Praeger publishers. 1986, 69-102.
7. Akhtar MS, Shahid AS. Termite populations and damage in cotton fields at Qadarpur, Multan, Pakistan (Isoptera). Sociobiology. 1989; 15(3):349-359.
8. Sunitha S, Miranda MT. Population dynamics of termites with special reference to *Odontotermes obesus* (Desneux)

(Isoptera: Termitidae). Asian Journal of Animal Science. 2011; 6(1):43–45
9. Gohel. Management of termite in groundnut. Master's thesis, Anand Agricultural University, Anand. 2013.
10. Bhanot JP, Verma AN, Kashyap RK. Population dynamics of termites in barley fields and correlation between termite population and termite damage. Zeitschrift fur Angewandte Entomologie.1984; 98(3):234-238.
11. Panwar AK. Monitoring of termites on cotton crop. International information system for the agricultural science and technology. 2019, 60-62
12. Sattar A, Salihah Z. Detection and control of subterranean termites. Technologies for Sustainable Agriculture. Proceeding National Workshop (Technologies for Sustainable Agriculture) Sept. 24-26 NIAB, Faisalabad, Pakistan. 2001, 195-198. Gadhiya VC. Survey and management of termites in wheat. Master's thesis, Anand Agricultural University, Anand. 2012.