2. Review of Literature

Review of literature regarding research in the past is a major concern and most important stage of any research to be conducted. Extensive review and deep study of literature helps the same to be up to the mark.

Extensive review of relevant literature till the date was made here to carry out the present study in a precise way. Floras of various regions, books regarding plant identification, description, ecological characteristics, methodologies etc., books of allelopathic, research journals, e- journals, Ph.D. and M. Phil. Thesis, related websites and other related literature were used for the purpose. This helped in developing a conceptual framework and an appropriate design for present study.

Major sources to obtain literature regarding related research were some well reputed organizations in the region of North Gujarat. A few of them were libraries of Hemchandracharya North Gujarat University, Patan, R.R. Mehta College of Science and C.L. Parikh College of Commerce, Palanpur. Many of known research personals were also consulted for the purpose. In the era of fast communication, internet was used at its extreme to review related research done in the past.

2.1 Floristic, Ecological Studies – A review

In view of large scale exploitation of useful diversity of various weeds species from Banaskantha district of North Gujarat, particularly for medicinal and other economical purposes, to determine the allelopathic effects of various weed species in different agricultural crops particularly in edible oil crops cultivated in different talukas of Banaskantha district in Gujarat the documentation of the weed species is very important.

Flora of Gujarat state (Shah, 1978) and Flora of Presidency of Bombay (Cooke, 1901) were described many species of various forest areas of Gujarat state but very little information is available regarding the weed species of Banaskantha district. Besides a few number of botanist have
contributed to understand the floristic account of Saurashtra, Central, Southern Gujarat and Northern Gujarat but none of them found helpful to know the exact status of the weeds flora of state particularly to the Banaskantha district. Flowering plants of Saurashtra, Central and Southern Gujarat had been studied earlier by Thaker (1910), Saxton and Sedgwick (1918), Sexton (1922), Santapau (1954), Sutaria (1954-55), Shah (1978), Jain (1991), Shashtri (1996) and Patel (2001)


Although the flora of North Gujarat is almost known. Moreover floristic and ecological research may also be carried out at any surveyed area repeatedly at regular intervals to find out changes taking place due to environmental changes and human interference.
2.2 Allelopathic Studies – A review

To have information about the previous work done on allelopathy in general, its role in different fields of agriculture, different types of interactions such as weed – weed, weed – crop, the impact of leachates, extracts and residues on recipient plants, allelochemicals existing in different donor plants, their chemical structures, mode of release of these ecochemicals in the environment, their accumulation, mechanism of action, their effect on seed germination, seedling growth, mineral nutrition, microbial activity in the soil etc. A review of literature is studied as under.

The earliest recorded observations of weed and crop allelopathy were made by none other than Theophrastus, "the father of botany", who in 300 B.C. wrote in his botanical works about how chickpea "exhausted" the soil and destroyed weeds. Cato the Elder (234–140 B.C.), the famous Roman politician and writer, was a farmer in his youth. In his book, he wrote about how chick pea and barley "scorch up" corn land. He also mentioned that walnut trees were toxic to other plants. Although this form of plant–plant interference had been known for quite some time, it was only recently (1937) that the Austrian plant physiologist, Hans Molisch, gave it a formal name, allelopathy (Molisch 1937), and as a consequence, he is currently recognized as the father of allelopathy.

Studies on allelopathy were made thousands of years before the term was coined by Molisch (1937). The term allelopathy is derived from two Latin words Allelon means each other and pathos means to suffer. He, for the first time studied the effect of numerous plant species and their plant parts viz.-roots, shoots, leaves, flowers, fruits, leachates, extracts and residues on seed germination, seedling growth and maturity of crops. Later on many scientists at different corners of the world, contributed to this field by carrying out the research on various aspects of allelopathy (Proskurnin et.al., 2003). At present the research on allelopathy is being carried out in more than 85 countries. Presently the allelopathy research work is mainly focused on identification of allelochemicals, their mode of action and ecological significance.
Allelopathy now refers to any process involving secondary metabolites produced by plants, microorganisms, viruses and fungi that influence the growth and development of agricultural and biological systems. The allelopathy researchers like Bhatt and Chauhan (2000), Singh and Rao (2003) and Leather and Einhellig (2005) also claimed that secondary metabolites produced by donor plants, when released into environment, play a key role in ecology and physiology of recipient plants. They further advocated that the released allelochemicals as well as the phytochemicals present in the leachates/extracts have stimulatory or inhibitory influence on seed germination, seedling growth and yield of recipient plants.

The history and the science of allelopathy as an area of research are being reviewed comprehensively by Willis (2000). Blum et.al., (1999) proposed three criteria to provide proof for allelopathy: (1) There must be production and release of chemicals by the donor or aggressor plants (2) Organic complexes distribution and accumulation in soil must be in adequate quantity to prevent nutrient and/or water uptake through roots and (3) Plant inhibition patterns found in the field cannot be attributed solely to physical factors or other biotic factors. The physiologists, soil scientists, weed scientists and natural products chemists are continuing to study this challenging area and publications in the field of allelopathy are increasing exponentially (Macias, 2002).

The allelopathic effects of weeds on crop plants have been intensively studied since 1970 (Rice, 1984). It is likely that in the near future allelopathy will be used in crop protection, agroforestry and agrohorticulture practices in developed and developing countries.

Allelopathic crops can be used to control weeds by:

1. Use of crop cultivars with allelopathic properties
2. Application of residues and straw of allelopathic crops as mulches
3. Use of an allelopathic crop in a rotational sequence where the allelopathic crop can function as a smother crop or where residues are left to interfere with the weed population of the next crop
Furthermore, suggestions for the use of allelopathy in weed control also include the application of allelochemicals or modified allelochemicals as herbicides.

The beneficial allelopathic effects of any weed or crop on another weed can be exploited to prepare eco-friendly, cheap and effective green herbicides. Similarly the negative allelopathic effects of many weeds or crops on another crop can be utilized to develop growth-promoting substances (Oudhia and Tripathi, 1998, 1999).

Today this subject has come into lime-light because of its multidisciplinary nature, which covers agriculture, biological sciences, biochemistry, physiology, biotechnology and even genetic engineering.

- Vilai-Santisopasri (2003), studied the allelopathic effects of *Eupatorium adenophorum* Spreng. on growth of some crops and weeds.
- Hierro and Callaway (2003), had investigated in detail the invasion of exotic plants and their role in allelopathy.


In India, weeds alone are responsible for about one-third loss in crop production (Bhan and Sushil Kumar, 1998). Weed affects crops through direct competition for light, nutrient and water as well as through allelopathy. The allelopathy is related to production and release of some beneficial or harmful chemicals into the environment by one plant (including microorganism) on another (Rice, 1984). The harmful effects may be indicated in the form of inhibition of seed germination, reduced root growth and metabolic activities etc.

Significant yield loss in oil crops is mainly due to competition, allelopathic effects of weeds and contamination of harvested products. Competition is defined as that condition that exists when requirements of one or more organisms living in a community cannot be obtained from the available resources. According to Cheema and Khaliq (2000) allelopathy is the direct or indirect harmful effect by one plant on another, through production of compounds that escape into the environment.

Annual oil-crops and young trees are more sensitive to competition from weeds. Weed competition is greatest early in the crops life, because weeds have a tendency of out growing the crop if they are not controlled early in the growth period. Apart from reduction in crop yield, weeds reduce both the quantity and quality of harvested products, increase incidence of diseases and insects; and frequently hamper efficient use of equipment (Americanos, 1994).

Several workers like Tripathi et.al., (2000), Bhalerao (2003), Guha et.al., (2004), Pawar (2004), and Ghayal et.al., (2009) have investigated photosynthetic pigments, photosynthetic rate, carbohydrates, proteins, phenols, proline, glycine betaine, mineral constituents and activities of various types of antioxidant enzymes in different alien and native weeds. Such types of investigations have given explanations for their luxuriant growth, high reproductive abilities and tolerance to biotic and abiotic stresses.

2.2.1 Review at World level

In the last two decades there has been an increase in publications on allelopathy and a considerable amount of literature is available that implicates
allelopathy as an important form of plant interference. In the world the researchers like Abdul-Wahab and Al-Naib (1972); Eihhellig and Rasmussen (1973); Anderson et al. (1978); Amritphale and Mall (1978); Dhyani (1978); Hussain et al. (1987); Colton and Eihhellig (1980); Datta and Chatterjee (1980a and 1980b); Drost and Doll (1980); Gonzalez de la Parra et al. (1981); Datta and Chakraborti (1982); Datta and Dasmahapatara (1984); Abu-Irmaileh and Qasem (1986); Bradow and Connick (1987); Datta and Ghosh (1987); Inam et al. (1987); Cote and Thibault (1988); Alam and Azmi (1989); Goel et al. (1989); Alsaaadawi et al. (1990); Jimenez-Osornio et al. (1996); Lydon et al. (1997) made important contributions to let the world know the allelopathic effect of weeds on agricultural field.


2.2.2 Review at country level

In India limited number of workers like Rajan (1973); Bhatia and Chawan (1976); Kanchan (1980); Jha and Sen (1981); Bansal and Sen (1982); Bhowmik and Doll (1983); Archhireddy and Singh (1984); Biswas and Chakraborti (1984); Kohli et al. (1985); Srivastava et al. (1985); Singh et al. (1989); Agarwal (1992); Agarwal and Kohli (1992); Kohli and Rani (1992); Singh et al. (1992); Bhatt et al. (1994); Narwal (1994); Dhawan and Dhawan (1995); Leela (1995); Madhu et al. (1995); Mehta et al. (1995); Velu and Rajagopal (1996); Batish et al. (1997); Evans (1997); Inderjit and Dakshini (1998); Oudhia and Tripathi (1999); and Oudhia (2000) have contributed to know the allelopathic effect of weed in crop field.

2.2.3 Review at state level

A few workers like Christie (1992); Patel and Jain (1997); Oudhia et al. (1998a); Dave and Jain (2009); Vijay and Jain (2009); Rawal and Jain (2011); Kumbhar and Dabgar (2010, 2011) have made some important
contribution to understand the allelopathic studies in the Gujarat.

2.3 in vitro pollen germination – A review


Accordingly, many Indian researchers viz. Tanaka, (1981); Shivanna and Johri (1985); Jain and Shah (1991); Shivanna and Rangaswami (1992); Nair and Nayar (1997); Patel and Jain (1997); Shukla and Misra (1997); Hoque and Arima (2000); Dabgar and Jain (2001); Jha (2002); Dabgar (2002); Singh (2005); Kumar (2008); Rathore (2008); Sharma (2008); Kumari et.al., (2009); Dave and Jain (2009); Soni et.al.,(2010) and Kumbhar and Dabgar (2012) has made an important contribution on studies of in vitro pollen germination.

Keeping in mind the research work associated to the subject described above, it is apparent that although much research has been performed on crops and weeds competition under various agro ecological conditions of the world. The implications of allelopathy for weed management need to be understood well again. Therefore, studies pertaining to allelopathic effect of weed on edible oil crops of Banaskantha district is call for focus of present research work.

2.4 Ethno-medicobotanical studies – A review

Indigenous knowledge is an old as human civilization but the term “Ethanobotany” was first applied by an American Botanist Harshberger in 1895 to the study of plants used by the primitive and aboriginal people. Later, Jones (1941) and Ford (1978) redefined Ethanobotany as “The study of direct interaction between human and plant population through its culture each human population classified plants, develops attitude and beliefs and learns the use of plants, while human behavior has a direct impact on the plant communities with which they interact, the plant themselves also impose limitation on human, these mixture interactions are the focus of ethanobotany”
Studies on ethnobotany have been initiated by Janki Ammal as an official program in the economic botany section of Botanical Survey of India since its very inception in 1954. Although the numbers of publication have been published on ethnobotanical studies in the country but limited number of ethnobotanical work had been done so far in the state of Gujarat. However, a few ethnobotanist like Pade (1966); Govindiah (1981); Karthikeyan et.al., (1981); Baily and Day (1989); Jain (1991); Shastri (1996); Bhatt et.al., (2001); Patel (2002 and 2003); Kanajariya (2009) and Patel et.al., (2010) have made important contribution in the field of ethnobotanical studies in the state, while Patel (2001), Ant (2000), Prajapati (2002), Patel (2004), Patel et.al., (2005), Patel (2009) and Patel (2010) contributed the same for North Gujarat.