INTRODUCTION
Plants are unique to produce identical or analogous bio-molecules, called secondary metabolites which are not directly associated with their own growth and nutrition rather gives us medical support (Springjob & Saito, 2002). According to Jivak, a doctor of the age of Buddha stated that there is no single plant in this world which does not provide medicinal value (Achari, 2008). Still not the all but some selective medicinal plants are present in India which are regularly utilised in Ayurveda, Unani or Homeopathic medical system.

After the Second World War more emphasis was given to synthetic and chemical drugs. Antibiotic groups were also been invented. But this is the right time to come back to bio-products again as they do not have any side-effects. According to a recent survey report the people of developed countries use 25% herbal medicines of their total medicine consumption, not only that but also 80% of total world’s population still depends upon herbal medicines to protect themselves (Achari, 2008).

Some herbal secondary metabolites have even become common to us like Quinine from Chincohona, Morphin from Opium, Reserpine from Rauwolfia, Strichnin from Nux, Azadirechtin from Azadirechta etc. With the development in technology, HPLC, NMR, Mass Spectro etc. the important active ingredients of medicinal plants are identified, qualified by scientists very easily (Dey, 2002). The molecular structures of many active medicinal bio-molecules are identified and therefore patentised & are also synthetically produced. The world-wide successfully used anti-cancerous drugs vincristin & vinblastin are extracted from the plant, Vinca rosea and Taxol from Taxus brevifolia plants (Achari, 2008).

According to a report of WHO the amount of trading of medicinal plants and medicinal plants related medicines will be 3 billion US dollar / year on 2020 & 5 billion US dollar/year on 2025. It also speaks that our India is one of the eight countries who can participate in this type of world-wide business (Information regarding Promotional and Commercial Projects 2008-09, WBSMPB, www.wbhealth.gov.in)

During the year 2004-05 Indian exports of Isabgol (Plantago Orata) & Senna Leaves (Cassia augustifolia) were almost above 40,000 metric tonnes largely in raw form. Another hot cake is Aloe vera, which is utilised in every cosmetic product. Most of farmers under survey are associated with cultivation of Aloe. Farmers are trying to harvest 1 ton /day of medicinal plan
in their field to get financial support from National Agricultural & Rural Development Bank [This is a required criteria of the bank for their support].

*Andrographis paniculata* is a herbaceous plant in the family Acanthaceae. In Southern and South-eastern Asia, it is used to treat infections and some diseases, often being used before antibiotics were created. *Andrographis paniculata* is extremely bitter in taste in all parts of the plant body. The plant is known in north eastern India as Maha-tita, literally "king of bitters", and known by various vernacular names. As an Ayurveda herb it is known as Kalmegh or Kalamegha, meaning "dark cloud". It is also known as Bhui-neem, meaning "neem of the ground", since the plant, though being a small annual herb, has a similar strong bitter taste as that of the large Neem tree (*Azadirachta indica*). In Malaysia, it is known as Hempedu Bumi, which literally means 'bile of earth' since it is one of the bitterest plants that are used in traditional medicine. The genus *Andrographis* consists of 28 species of small annual shrubs essentially distributed in tropical Asia. Only a few species are medicinal, of which *Andrographis paniculata* is the most popular (Kumar et al., 2012).

**ORIGIN AND DISTRIBUTION OF KALMEGH**

*Andrographis paniculata* is native to Taiwan, Mainland China, and India. It is also commonly found in the tropical and subtropical Asia, Southeast Asia, and some other countries including Cambodia, Caribbean islands, Indonesia, Laos, Malaysia, Myanmar, Sri Lanka, Thailand, and Vietnam (Niranjan et al., 2010, Wu et al., 1996, Dutta et al., 2012). This plant is also found in different phytogeographical and edaphic zones of China, America, West Indies, and Christmas Island (Dutta et al., 2012).

*Andrographis paniculata* are spread throughout south India and Sri Lanka which perhaps represent the centre of origin and diversity of the species. The herb is an introduced species in northern parts of India, Java, Malaysia, Indonesia, the West Indies, and elsewhere in the Americas. The species also occurs in Hong Kong, Thailand, Brunei, Singapore, and other parts of Asia where it may or may not be native (Kumar et al., 2012). The plant is cultivated in many areas, as well. Unlike other species of the genus, *Andrographis paniculata* is of common occurrence in most places in India, including the plains and hilly areas up to 500 m.
Picture showing world distribution of A. paniculata in green patches (By Dr. N Sasidharan (Dr. B P Pal Fellow), Kerala Forest Research Institute, Peechi)

**Taxonomic hierarchy**

Domain: Eukaryota,
Kingdom: Plantae,
Subkingdom: Tracheobionta,
Superdivision: Spermatophyta,
Division: Angiosperma,
Class: Dicotyledonae,
Subclass: Gamopetalae,
Series: Bicarpellatae,
Order: Personales,
Family: Acanthaceae,
Subfamily: Acanthoideae,
Tribe: Justiciae,
Subtribe: Andrographideae,
Genus: Andrographis,
Species: A. paniculata (Burm. f.) Nees. (Mishra et. al., 2007)
**Botanical Description**

[Jarukamjorn and Nemoto, 2008; Boopathi, 2000; Anju, 2012].

<table>
<thead>
<tr>
<th>Traits</th>
<th>Values/characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant height</td>
<td>30–110 cm</td>
</tr>
<tr>
<td>Stem</td>
<td>Dark green</td>
</tr>
<tr>
<td>Length</td>
<td>30–100 cm</td>
</tr>
<tr>
<td>Diameter</td>
<td>2–6 mm</td>
</tr>
<tr>
<td>Shape</td>
<td>Quadrangular with longitudinal furrows and wings on the angles of the young parts, slightly enlarged at the nodes</td>
</tr>
<tr>
<td>Leaves</td>
<td>Glabrous</td>
</tr>
<tr>
<td>Length</td>
<td>2–12 cm</td>
</tr>
<tr>
<td>Width</td>
<td>1–3 cm</td>
</tr>
<tr>
<td>Arrangement</td>
<td>Lanceolate</td>
</tr>
<tr>
<td>Shape</td>
<td>Pinnate, acute apex, entire margin</td>
</tr>
<tr>
<td>Flowers</td>
<td>White with rose-purple spots on the petals</td>
</tr>
<tr>
<td>Size</td>
<td>Small, in lax spreading axillary and terminal racemes or panicles</td>
</tr>
<tr>
<td>Seed</td>
<td>Capsules linear-oblant, acute at both ends</td>
</tr>
<tr>
<td>Size</td>
<td>1.9 cm × 0.3 cm</td>
</tr>
<tr>
<td>Color</td>
<td>Yellowish brown</td>
</tr>
<tr>
<td>Shape</td>
<td>Subquadrate, numerous</td>
</tr>
<tr>
<td>Flowering and fruiting</td>
<td>December to April</td>
</tr>
</tbody>
</table>

**Morphology of Andrographis paniculata.** (a) Mature *A. paniculata* in polybag stage, (b) flowering stage, (c) harvested seeds, (d) in vitro seedling, (e) young *A. paniculata* in polybag, (f) adventitious roots of *A. paniculata*, and (g) vegetative seedlings. Single direction of arrow indicates the developmental stages and both directions of arrow denote vegetative propagation of plant.
**Parts used**

To extract the required medicinal constituents from Kalmegh generally whole plant is used but main source of the above are the leaves and aerial parts (Dutta et. al., 2012)

**Phytochemical constituents**

*Andrographis paniculata* contains diterpenes, lactones and flavonoids. Flavonoids mainly exist in the root, but have also been isolated from the leaves. Aerial parts contain alkanes, ketones, and aldehydes and the bitter principles in the leaves were due to presence of the lactone andrographolide named kalmeghin. Four lactones – Chuanxinlian A (deoxyandrographolide), B (andrographolide), C (neoandrographolide) and D (14-deoxy-11, 12-didehydroandrographolide) were isolated from the aerial parts in China. A diterpene glucoside (deoxyandrographolide- 19beta-Dglucoside) has been detected in the leaves and six diterpenoids of the ent-labdane type, two diterpene glucosides and four diterpene dimers (bis-andrographolides A, B, C, and D) have been isolated from aerial parts. Two flavonoids identified as 5, 7, 2’, 3’- tetramethoxyflavanone and 5-hydroxy-7, 2’, 3’- trimethoxyflavone were isolated from the whole plant, while 12 new flavonoids and 14 diterpenoids have been reported from the aerial parts. Two new flavonoid glycosides and a new diterpenoids (andrographic acid) were recently reported, and two new ent-labdane diterpenoids glycosides were isolated from the aerial parts. The major compound is andrographolides, which were first isolated by Gorter (1911). These are diterpene containing a γ - lactone ring connected to a decalin ring system via an unsaturated C2 moiety, including Andrographolide, Neoandrographolide, Deoxyandrographolide and Dehydroandrographolide (Abeysekera et al., 1988)

- The structural diagram of three main biochemicals of *A. paniculata*
VI. Medicinal property of Kalmegh

As it is a very potent medicinal herb extensively used in both Ayurvedic and Homoeopathic system for its anti-inflammatory, antibacterial, antiperiodic, antipyretic, antithrombotic, antiviral, hypoglycemic, hepato protective, choleretic properties (Kapil et. al., 1993). Even its property as anticarciogenic is well established, specially against colon cancer (Puri et. al., 1993). In modern investigation the andrographolide (the main active ingredient) shows antineoplastic effect due to its ability to arrest cell cycle and control apoptosis (Varma et. al., 2009). Some of the medicinal properties of Kalmegh are described below:

1. HEPATOPROTective EFFECTS

*Andrographis paniculata* is extensively used as a hepatoprotective agent in Indian systems of medicine. *Andrographis paniculata* is also an ingredient in several polyherbal preparations used as hepatoprotectants in India, one of which has been reported as efficacious in chronic hepatitis B virus infection. Most studies for hepatic effects have been conducted. Shukla et. al., 1992 reported significant choleretic effects of andrographolide in rats and guinea pigs. The protection of andrographolide against acetaminophen-induced reduction in volume and contents of bile was better than that produced by silymarin. Multiple-dose pretreatment with arabinogalactan proteins and andrographolide was protective against ethanol induced hepatotoxicity in mice and was deemed comparable to the efficacy of silymarin. Choudhury and Poddar, 1983 reported that oral pre and post-treatment of adult rats with an extract of *Andrographis paniculata* was protective against ethanol-induced increase in serum transaminase. Administration of the extract to normal adult rats in single and multiple doses for seven and 15 days did not significantly affect serum transaminase. A comparative study on the effect of leaf extract or andrographolide on carbon tetrachloride (CCl4)-induced hepatic microsomal lipid peroxidation revealed a protective effect of a single oral dose of the extract and of andrographolide. However, high concentration CCl4-induced microsomal lipid peroxidation in vitro was completely protected by the extract but not by andrographolide, indicating that the hepatoprotective effect is not solely due to the presence of andrographolide. Handa and Sharma, 1990 compared andrographolide, methanol extract of the whole plant containing equivalent amounts of andrographolide, and an andrographolide-
free methanol extract against CCl4-induced liver damage in rats. The CCl4-induced increases in serum transaminase, serum alkaline phosphatase, serum bilirubin, and hepatic triglycerides were inhibited by 48.6-, 32- and 15 percent, for andrographolide, methanol extract, and andrographolide-free methanol extract, respectively. Since all three treatments resulted in improvement in liver histology. Trivedi et. al., 2007 observed protection by both the crude extract of Andrographis paniculata and andrographolide against reduced activities of hepatic antioxidant enzymes (superoxide dismutase, catalase, and glutathione peroxidase), depletion of hepatic glutathione, and increased activities of hepatic glutamyl transpeptidase, glutathione-S-transferase, and lipid peroxidase caused by hexachlorocyclohexane in mice. Oral or ip. Pretreatment with andrographolide was also protective against galactosamine-induced liver damage in rats and prevented changes in biochemical parameters and liver histology. Similar protection was observed when rats were treated with andrographolide postacetaminophen challenge and on an ex vivo preparation of isolated rat hepatocytes. All showed hepatoprotective effects. A. paniculata also showed benefits against liver damage caused by agents with different hepatotoxic mechanisms (Kumar et. al., 2012).

2. ANTIMICROBIAL AND ANTI-PARASITIC EFFECTS

Andrographis paniculata has been extensively shows antimicrobial and antiparasitic activities. Such as bacteria, viruses, and parasites. Singha et. al., 2003 reported significant antibacterial activity of an aqueous extract and attributed it to the combined effect of andrographolides and arabinogalactan proteins. A similar conclusion was reached by Zaidan et. al., 2005 who found crude aqueous extract of leaves exhibit significant antimicrobial activity against gram positive S. aureus, methicillin-resistant S. aureus and gram-negative Pseudomonas aeruginosa, but had no activity against Escherichia coli or Klebsiella pneumoniae. Andrographolide, neoandrographolide, and 14-deoxy-11, 12-didehydroandrographolide are reported to be viricidal against herpes simplex virus 1 (HSV-1) without having any significant cytotoxicity at viricidal concentrations. Alcoholic extract of the rhizome was reported to possess significant in vitro activity against Ascaris lumbricoides. Chloroform extract completely inhibited malarial parasitic growth within 24 hours of incubation at a concentration of 0.05 mg/mL. Same inhibition was achieved in 48 hours with methanol extract at a concentration of 2.5 mg/mL. Mishra et. al., 2009 found that a methanol
extract significantly inhibited Plasmodium falciparum at a 50-percent inhibitory concentration (IC50) of 7.2 µg/mL.46 "e four xanthones – 1,8- dihydroxy-3,7-dimethoxyxanthone, 4,8-dihydroxy- 2,7-dimethoxyxanthone, 1,2- dihydroxy-6,8- dimethoxyxanthone, and 3,7,8-trimethoxy-1- hydroxy-xanthone – isolated from the roots of the plant, also showed in vitro anti-malarial activity against Plasmodium.

3. ANTIOXIDANT AND ANTI-INFLAMMATORY ACTIVITIES

Antioxidant and anti-inflammatory activities have been reported by various investigators. Das et. al., 2009 reported that nicotine-induced inhibition of mitochondrial electron chain complexes and the resultant increase in nitric oxide (NO) in different parts of rats’ brains was prevented by simultaneous treatment with the water and ethanol extracts of A. paniculata or andrographolide; the water extract exhibited greater antioxidant activity than the ethanol extract. Phytochemical analysis showed higher flavonoid but lower phenol contents in water extract than in ethanol extract. Andrographolide also fully restores the maximal contractile response of thoracic aorta to phenylephrine after incubation with LPS, and attenuates the fall in mean arterial blood pressure of anesthetized rats due to LPS. Unlike andrographolide, neoandrographolide was also effective ex vivo in suppressing NO production when macrophages were collected after oral administration of neoandrographolide and subjected to LPS stimulation. Andrographolide inhibited LPS-induced increase in tumor necrosis factor-alpha (TNF) and granulocyte-macrophage colony stimulating factor. Neoandrographolide also inhibits PGE2 synthesis and TNF-in LPS stimulated macrophages, and its oral administration to mice significantly suppresses dimethylbenzene-induced ear edema and acetic acid-induced vascular permeability.

4. ANTIHYPERGLYCEMIC AND HYPOGLYCEMIC EFFECTS

Water extract of Andrographis paniculata significantly prevents orally administered glucose-induced hyperglycemia in non diabetic rabbits without affecting epinephrine-induced hyperglycemia. Chronic administration of the extract for six weeks also showed no effect on fasting blood glucose level. However, ethanol extract, administered orally twice daily for 14 days to streptozotocin induced diabetic rats significantly reduced fasting serum glucose and
increased body weight in a dose-dependent manner. The extract also significantly lowered levels of thiobarbituric acid-reactive substances in liver and kidney compared to vehicletreated rats, while significantly increasing the activity of superoxide dismutase and catalase enzymes and hepatic glutathione concentrations in diabetic rats. An ethanol extract at a dose of 400 mg/kg body weight twice daily for two weeks to diabetic rats produced a 49.8-percent reduction in fasting serum triglyceride levels. It was greater than the 27.7-percent decline achieved with 500 mg/kg body weight Metformin twice daily for 14 days. An aqueous extract (50 mg/kg body weight) given to streptozotocin-diabetic rats resulted in a 52.9-percent decrease in blood glucose levels. Freeze-dried material decreased blood glucose by 61.8 percent at a lower dose of 6.25 mg/kg body weight by Dandu and Inamdar, 2009. Kumar et al., (2012) administrated an aqueous extract of *Andrographis paniculata* leaves. A dose of 400 mg/kg lowered blood glucose level of streptozotocin-induced animals and increased activity of superoxide dismutase and catalase. Oral administration of the decoction also significantly reduced blood glucose levels in alloxan-induced diabetic rats, and reduced food and water intake compared to vehicle-treated diabetic controls. Extended mean estrous cycles (eight days) were reduced to five days in treated diabetic rats. Andrographolide appears to dose-dependently reduce plasma glucose concentration in streptozotocin-induced diabetic rats and normal rats, with a more marked effect in normal rats than in diabetic rats. It is a significant difference from the water extract, which did not show a glucose lowering effect in one study of normoglycemic rats. Andrographolide also attenuates the increase in plasma glucose in response to an intravenous glucose challenge in normal rats and enhances the uptake of radioactive glucose by isolated soleus muscle of streptozotocin-diabetic rats in a concentration dependent manner. Repeated intravenous administration of andrographolide in diabetic rats for three days resulted in an increase in mRNA and protein levels of glucose transporter (GLUT4) in the soleus muscle, an indication that the glucose-lowering effect of andrographolide could be due to better glucose utilization by skeletal muscle. However, after in vitro experiments, Wibudi et al. (2008) concluded that the hypoglycemic effect of *Andrographis paniculata* is due to insulin release from pancreatic cells through ATP sensitive potassium channels, similar to other insulin tropic antidiabetic agents. In vitro experiments conducted by Subramanian et al., 2008 suggested that inhibition of alpha-glucosidases and alpha-amylase enzyme could be the mechanism by which the ethanol extract of *Andrographis*
*Andrographis paniculata* and andrographolide produce hypoglycemic effect. Available evidence suggests that the hypoglycemic and Antihyperglycemic activities of the extract and andrographolide may involve different mechanisms in normal and diabetic conditions. Water extract seems to be a more suitable candidate for further studies as it does not affect fasting blood glucose levels of non diabetic animals. Identification of blood glucose-lowering constituents in both water and ethanol extracts may be of value.

5. **EFFECTS ON REPRODUCTIVE SYSTEMS**

A number of animal studies report an effect of *Andrographis paniculata* on male and female reproduction. Early reports of oral administration of powdered stem indicated an antifertility effect in male Wistar mice, but no impact on fertility in female mice. In has also been reported that administration of *Andrographis paniculata* resulted in abortion in pregnant rabbits. Intraperitoneally injection of the decoction of aerial parts to female albino mice was reported to prevent implantation and caused abortion at different gestation periods. Early pregnancy was also terminated by intramuscular, subcutaneous, and intravenous administration. Administration of progesterone or luteinizing hormone-releasing hormone completely or markedly antagonized the abortifacient effects, indicating an interference with progesterone activity as a potential mechanism for this abortifacient effect. In addition, the herb is reported to suppress growth of human placental chorionic trophoblastic cells in vitro. Zoha et al., 1989 fed female mice sun-dried *Andrographis* powder at a dose of 2 g/kg body weight/day for six weeks. When they were mated with untreated males of proven fertility, pregnancy was inhibited in 100 percent of the animals. Conversely, more than 95 percent of untreated female mice in the control group became pregnant when mated with males in a similar fashion. Akbarsha et al., 1990 administered dry leaf powder to male albino rats (20 mg daily for 60 days) reported inhibition of spermatogenesis, degenerative changes in the seminiferous tubules, regression of Leydig cells, and regressive and/or degenerative changes in the epididymis, seminal vesicle, ventral prostate, and coagulating glands. Andrographolide also produced similar results when orally administered to male Wistar albino rats for 48 days. Sperm count and sperm motility were decreased and sperm abnormalities were noted. However, Burgos et al., 1997 found no testicular toxicity in male Sprague Dawley rats after
treatment with a standardized dried extract in doses of up to 1,000 mg/kg daily for 60 days. Its analysis was based on testicular weight and histology, ultra structural analysis of Leydig cells, and testosterone levels. Extract of *Andrographis paniculata* also did not affect the progesterone levels in pregnant rats when administered orally in doses of 200, 600, and 2,000 mg/kg daily during the first 19 days of pregnancy. Burgos *et. al.*, reported that dried extract of *A. paniculata* induces uterine relaxation by blocking voltage-sensitive calcium channels. A phase I clinical study on Kan-Jang (a combination of *A. paniculata* and *Eleutherococcus senticosus*) reported no significant negative effects on sperm quality and fertility of healthy adult males.

6. EFFECTS AS ANTICARCINOGEN

*Andrographis paniculata* aqueous extract significantly enhanced CAT, SOD and GST activities in the liver of lymphoma bearing mice, experimented by Verma and Vinayak, 2008.

Animal and in vitro experiments using human cancer cell lines to investigate the potential anticancer effects of *A. paniculata* have found andrographolide responsible for the observed effects rather than other diterpenes by Kumar *et. al.*, 2004, Nanduri *et. al.*, 2004, Zhou *et. al.*, 2006. Various mechanisms of action have been proposed, including enhancement of chemokine activity, inhibition of tumor-specific angiogenesis affecting cell cycle progression, and induction of apoptosis by Nanduri *et. al.*, 2004, Zhou *et. al.*, 2006, Sheeja *et. al.*, 2007, Ji *et. al.*, 2005. Cancer cell lines investigated include prostate, breast, cervical, colon, hepatoma, melanoma, and lymphocytic leukemia. Researchers are now focusing on synthesizing compounds based on andrographolide to improve selectivity and potency (Nanduri *et. al.*, 2004, Jada *et. al.*, 2006). The need for caution has been raised by one group of researchers because andrographolide-enhanced SDF-1-chemokine activity might induce tumor cell metastasis, found by Ji *et. al.*, 2005. *A. paniculata* extract has also induced cell differentiation in mouse myeloid leukemia cells. Matsuda *et. al.*, 1994.

VII. OBJECTIVES OF THE PRESENT STUDY:

This multipurpose plant has high demand in pharmaceutical industries. As per survey report of West Bengal Medicinal Plant Board (WBMPB) total consumption of Kalmegh was 16292
kg in 2009-2010 only in West Bengal. A data is below provided by West Bengal Medicinal Plant Board (WBMPB):

<table>
<thead>
<tr>
<th>Serial no.</th>
<th>YEAR</th>
<th>CONSUMPTION (Kg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2007-2008</td>
<td>13390.835</td>
</tr>
<tr>
<td>2</td>
<td>2008-2009</td>
<td>11537.320</td>
</tr>
<tr>
<td>3</td>
<td>2009-2010</td>
<td>16292.5</td>
</tr>
<tr>
<td>4</td>
<td>2011-2012</td>
<td>10214.58</td>
</tr>
<tr>
<td>5</td>
<td>2012-2013</td>
<td>16491.55</td>
</tr>
</tbody>
</table>

Due to high market demand WBMPB is also giving stress for cultivation of 32 important medicinal plants; Kalmegh is one of them (West Bengal State Medicinal Plant Board, www.wbhealth.gov.in). According to a report of task force on conservation and sustainable use of medicinal plants; Govt. of India 2000, cost of cultivation of Kalmegh is Rs. 10,000/ha and the net return is Rs.33,000/ha. Because of its high remunerative return farmers should be encouraged to cultivate this important medicinal plant. Another prospective side of cultivation of Kalmegh is that, cultivation of such plants even possible in soils which are proved sterile to other crop cultivation. As it is observed that quantity of secondary metabolites increases in stressed condition therefore it may be approached to non-potential soils for cultivation. Specially after Tsunami or Aila affected soil can be proved as potential in Kalmegh cultivation.

More than 90% of the species used in trade continued to be provided from wild life of which about $\frac{2}{3}$rd are harvested by destructive means. Due to unplanned & wild harvesting many of the medicinal plants have become endangered (Rao et. al., 2009). Kalmegh is also not an exception. So, for long term sustainability of medicinal plants it needs to be shifted from wild to the cultivated sources. (Information regarding Promotional and Commercial Projects 2008-09, WBSMPB, www.wbhealth.gov.in.)

It is a matter of great concern that farmers in general are growing and supplying medicinal plants of poor grade having quality of not upto the mark with low output of active principles because of inadequate scientific back up in plant development and farming as well. The life saving drug formulations from such low grade medicinal herbs as sources of raw ingredients often fail to maintain the expected quality grade which is must for any medicinal application.
With the ever increasing demand for quality medicinal plants immediate scientific attention and endeavour have to be directed so as to develop and upgrade plants of medicinal values both in terms of genetic improvement and its agronomic management.

Though Kalmegh cultivation is very profitable neither good & positive approach has been made to intimate farmers in this regard nor any stable variety is available. Proper technical support is not available for Kalmegh cultivation. Farmers are cultivating depending on their own knowledge. They do not know about high yielding varieties or how to increase the active ingredient content in dry matter. As the secondary metabolites act as the active principle of medicinal plants their quantitative estimation and yield should be improved. High yielding varieties are yet to be developed through scientific ways. Though India has better potentiality in producing medicinal plants but our export is not good till now as during quarantine the raw materials are rejected due to low percentage of active principle content. Finding or developing high yielding varieties with high level of active ingredient of Kalmegh is therefore very urgent and for that proper evaluation of the kalmegh genotypes are very much essential. Once we indentify proper genotype of Kalmegh there is enough potential to improve the crop through breeding procedure and as we know the economic part of the Kalmegh is its vegetative portion we may apply polyploidy breeding for the improvement of the crop.

Unplanned cultivation and harvesting of Kalmegh is done as farmers do not know the exact growth phase of the plant at which the plants contain specific & required active principle in maximum quantity (Banerjee & Dutta-1991). They also do not know the exact plant part required for extraction. Therefore development of better management practice in field to improve active ingredient quantity for getting maximum vegetative as well as biochemical yield should be done immediately. As it is observed that quantity of secondary metabolites increases in stressed condition therefore it may be approached to cultivate Kalmegh in non-potential soils like saline or drought. Though it has enough potential to grow in drought prone area and saline area if irrigation provided for early developmental stages, therefore probability of promotion of cultivation of Kalmegh to saline or drought prone areas where other crops are not cultivated may become beneficial in terms economy as well as land utilization. The seeds are dormant also and even if planted during winter it does not grow very well. There are different researches going on to overcome such dormancy problem. So we may cultivate the
crop through ratooning and to observe whether there is any morphological or biochemical upgradation in comparison to the crops propagated by seeds.

Medicinal Plants are not only useful to cure our diseases rather they also have some active ingredients which provide protective measures to plant diseases also. Some active principles like azadirectin of *Azadirecta indica*, Nicotin of *Nicotiana tabacum*, rotenon of *Derris* sp, Pyrithrin of *Chrysanthmum* sp. are well known biopesticides which are use to control different pests in sustainable agriculture. They may be cultivated with other crops by intercropping management or for crop rotation (Nair, 1991) As for example Pegion Pea/Maize + *Andrographis* / *Chlorophytum* intercropping system were proved to be advantageous over soul cropping (Yaseen and Tripathi, 2009). So here an attempt has also made to observe the usefulness of the active ingredient of Kalmegh as biopesticide as well as yield improvement. So the present observation comprises of following objectives:

I. Collection and evaluation of Kalmegh germplasms.
II. Imposition of abiotic stresses and other management practice for morphological and biochemical upgradation of kalmegh germplasm.
III. Induction of colchiploid on selected germplasm.
IV. Kalmegh as a biopesticide and for the improvement of viability, vigour and productivity in cereals and pulses.
VIII. REFERENCES


