1. Introduction

Chilli pepper (*Capsicum annuum* L) is one of the most important commercial crop of India belongs to the solanaceae family which represents a diverse plant group (Marín et al., 2004; Liefting et al., 2009; Garcés-Claver et al. 2007; Harini and Sita, 1993; Prakash et al., 1988). Chilli has a very important position in our daily life throughout the globe as a vegetable as well as spice (Manoharan et al., 1998; Materska and Perucka, 2005; Oboh et al., 2007). It is highly rated for its unique pungency which adds value in culinary preparations (Kim et al., 2002; Sanatombi and Sharma, 2008; Taller et al., 1998). Capsicum plant is economic, cultural and biological importance due to the use of the fruits preparing dishes of typical culinary traditions (Aguilar-Meléndez et al., 2009; Lee et al., 2008). A wide variability of capsicum domesticated species are not yet fully known and exploited (Guzmán et al., 2005; Sudré et al., 2010; Ince et al., 2010a; Ince et al., 2010b).

The genus name Capsicum derived from the Latin word 'capsa' meaning chest or box because of the shape of fruit which encloses seeds very neatly, as in the box (Andrews, 1995; Palevitch and Craker, 1996; Bosland et al., 2012; Berke and Shieh, 2000). Chillies are cultivated mainly in tropical and sub-tropical countries like India, Japan, Mexico, Turkey, United States of America and African countries (Panda, 2010; Leff et al., 2004; Ram et al., 2007; Asati and Yadav, 2004; Rathore and Shekhawat, 2008). Genus Capsicum represents a diverse plant group which contains approximately 30 species, 5 of which *C. baccatum*, *C. annuum*, *C. chinense*, *C. frutescens* and *C. pubescens* are domesticated and cultivated in different parts of the world (Bosland, 1996; Andrews, 1995; Palevitch and Craker, 1996; Bosland et al., 2012; Pickersgill, 1971; Sudré et al., 2010). Among the five species of Capsicum cultivated, *C. annuum* is one of the most common cultivated crop worldwide (Pickersgill, 1997; Tong and Bosland, 1999; Aguilar-Meléndez et al., 2009; Bosland, 1996) followed by *C. frutescens* (Ince, 2010; Wang and Bosland, 2006; Bosland et al., 2012; Sukrasno and Yeoman, 1993; Schweiggert et al., 2006).

India has become world's largest producer and exporter of chilli, exporting to USA, Canada, UK, Saudi Arabia, Singapore, Malaysia, Germany and many countries

across the world (Indian horticulture database, 2011; Jagtap et al., 2012; Sanyal et al., 2008; Jagtap et al., 2012). Chillies are excellent sources of vitamin A, B, C and E with minerals like molybdenum, manganese, foliate, potassium, thiamine and copper (Vega-Gálvez et al., 2009; Chuah et al., 2008; Bajaj et al., 1979). Chilli is believed to have been introduced to India by Portuguese explorers (Singh et al., 1993; Basu and De 2003) and North Eastern India by Christian Missionaries (Dhaliwal and Jindal, 2014; et al., 2014). Pungency in chillies due to Capsaicin and its analogues, collectively called Capsaicinoids (Stewart et al., 2005; Reilly et al., 2001; Tanaka et al., 2009). Scoville organoleptic test heat units (Scoville, 1912) measures the pungency among chili varieties (Batchelor and Jones, 2000; Bosland, 1996; Reilly et al., 2001; Sanatombi and Sharma, 2008). Given lacking the qualitative and quantitative data on the various varieties of chillies in Kerala, the objectives of this research work is to 1) characterize the varieties based of morphological features 2) potential used of various chili extract as a bio-control agent against various target groups (mosquito larvae, snail and fish).

1.2 Taxonomical classification

- Kingdom - Plantae
- Sub Kingdom - Trachobionta
- Division - Magnoliophyta
- Class - Equistopsida
- Sub Class - Magnolidae
- Order - Solanales
- Family - Solanace
- Genus - Capsicum
- Species - annuum

Different varieties of chilies are found in Kerala. They are identified on the basis of their Morphology characteristic such as flower colour, fruit shape, fruit surface, number of flower per axil etc (pickersgill 1971; Moscone 2007; Ince 2009). Mainly the types of chillies found in Kerala include birds eye chilli and White birds eye chilli.

Table 1. Nutritive values of *Capsicum annuum* L. (Modified after Goplan, 2004).

Parameter	Dry chillies*	Green chillies*
Carbohydrates	31.60	3.00
Proteins	15.00	2.90
Fats	6.20	0.60
Minerals	6.10	1.00
Fibre	30.20	6.80
Calcium	160	30.00
Phosphorous	370.00**	18.00**
Iron	2.30**	4.40**
Moisture	10.00	85.70
Carotene	345.00***	175.00***
Thiamine	0.93**	0.19**
Riboflavin	0.43**	0.39**
Niacin	9.50**	0.90**
Sodium	40.00**	-
Potassium	530.00**	-
Phosphorous	71.00**	7.00**
Magnesium	-	272.00**
Copper	-	1.40**
Molybdenum	-	0.07**
Zinc	-	1.78**
Chromium	-	0.04**
Caloric value	229	297

* Values in g per 100 g sample
** Values in mg; *** Values in µg

1.3 Hypothesis

The current research work is based on the following hypothesis: (1) morphological differences exist among chilli pepper varieties in Kerala; (2) Chilli extracts can be used as an effective bio-control agents for various target organisms; (3) antilarvicidal properties vary among the various morphological varieties of chilli peppers; (4) antilarvicidal activity also vary with the type of solvent used for extraction.

2. Materials and Methods

2.1 Study area

Kerala state covers an area of 38,863 km^2 with a population density of 859 per km^2 and spread across 14 districts. The climate is characterized by tropical wet and dry with average annual rainfall amounts to 2,817 ± 406 mm and mean annual temperature is 26.8°C (averages from 1871-2005; Krishnakumar et al., 2009).

2.2 Sample collection

Samples of *Capsicum annuum* L were collected based on an elaborative literature survey as well as information's collected from farmers. A total of 9 varieties were explored from different regions of the Kerala from December 2015 to February 2016. Locations of the sample collection areas were recorded using a Trimble Geoexplorer II (Trimble Navigation Ltd, Sunnyvale, California) and data were transferred using GPS Pathfinder Office software (Trimble Navigation Ltd, Sunnyvale, California).

2.3 Morphological characterization

Morphological characterization of *Capsicum annuum* L and specific characteristics of different varieties were studied. The instruments used to collect data are, Measuring scale (30 cm), tape (160 cm) weighing machine, camera, field book and twine. The samples were selected based on primary and secondary data. Parameters taken were leaf shape, leaf length, leaf color, flower colour, fruit colour at maturity, fruit shape, fruit length, fruit surface, fresh and dry weight of fruit, seed colour, seeds per fruit, fruit width at shoulder, stem colour, plant height, number of petals and fruiting nodes (Sudré et al., 2010).

Table 2. Descriptors for Capsicum based on IPGRI, 1995. (Modifed after Sudré, et al., 2010).

Descriptor	Variation
Morphological traits	
Stem colour	Green, green with purple, purple
Anther colour	Yellow, pale blue, blue, purple
Corolla colour	White, purple, white green
Number of flowers per axil	One, two, three or more
Flower position	Pendent, intermediate, erect
Plant growth habit	Compact, erect
Immature fruit colour	Yellow, green, orange, purple
Fruit colour at mature stage	White, pale orange, yellow, red and purple
Fruit shape	Elongate, triangular, almost round
Fruit surface	Smooth, semi wrinkled
Cotyledon colour	Light green, purple,
Neck at base of fruit	Absent (0), present(1)
Agronomic trait	
Plant height (cm)	50% of plants the first fruit has began to ripen
Plant canopy width (cm)	Measured immediately after first harvest at the widest point
Days to flowering	50% of plant have at least one open flower
Days to fruiting	50% of plant bear mature fruit
Fruit length (cm)	Measured at the largest point in 10 ripe fruits
Fruit width (cm)	Measured at the widest point as a an average of 10 ripe fruits
Mean fruit weight	Total fruit number
Number of seeds per fruit	Average of at least 10 fruits from 10 random plants
Number of fruits per plant	Counting the total of seeds per fruit
Fruit yield per plant	Total weight of all harvested fruits in each plant