Effect of sowing dates, climatic variables on major insect pests and host plant resistance to pod borer *Helicoverpa armigera* (Hubner) in pigeonpea (*Cajanus cajan* (L.) Millsp.)".







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➢To end of hunger and malnutrition and achieve food security and improve nutrition is at the heart of the sustainable development goals.

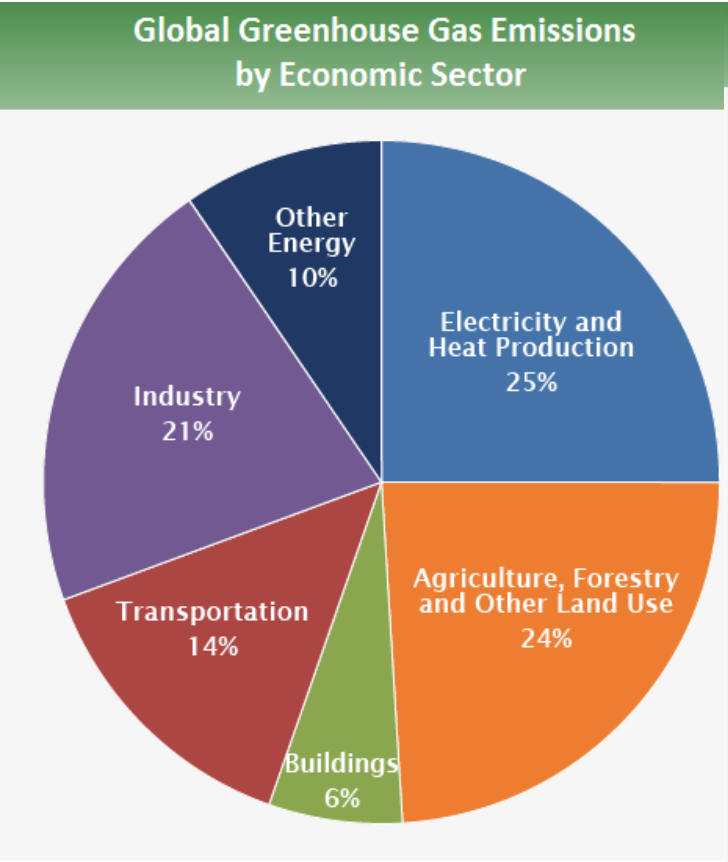
➢Almost 800 million people still undernourished,and161million under-five year olds are stunted (FAO, 2016).

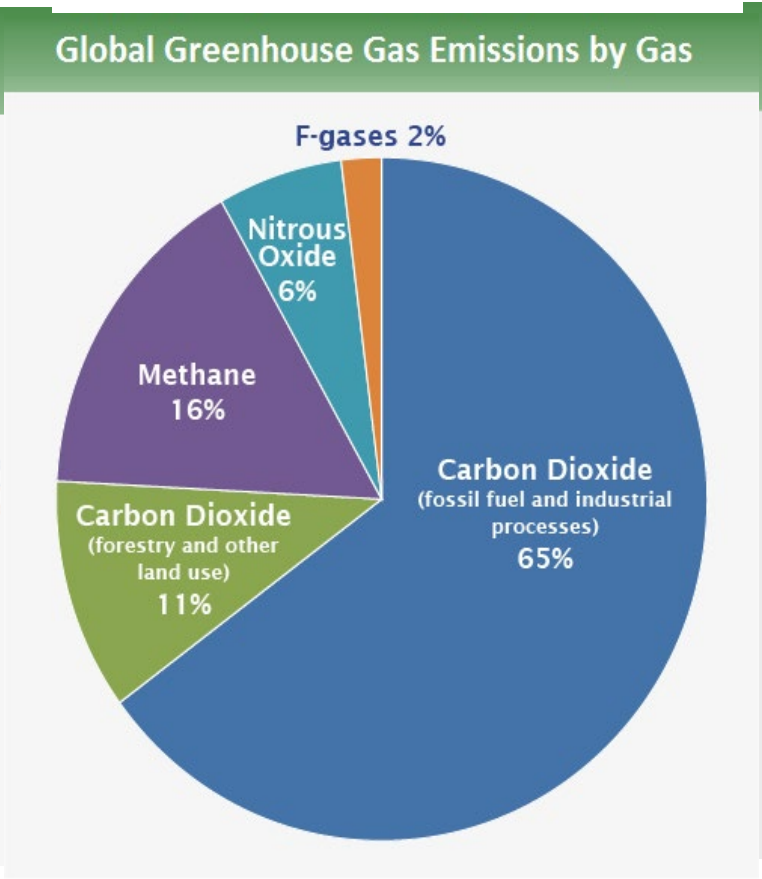
➢ It is estimated that 500 million smallholder farms in the developing world are supporting almost 2 billion people. In Asia and sub-Saharan Africa, these small farms produce about 80% of the food consumed (IFAD, 2011).

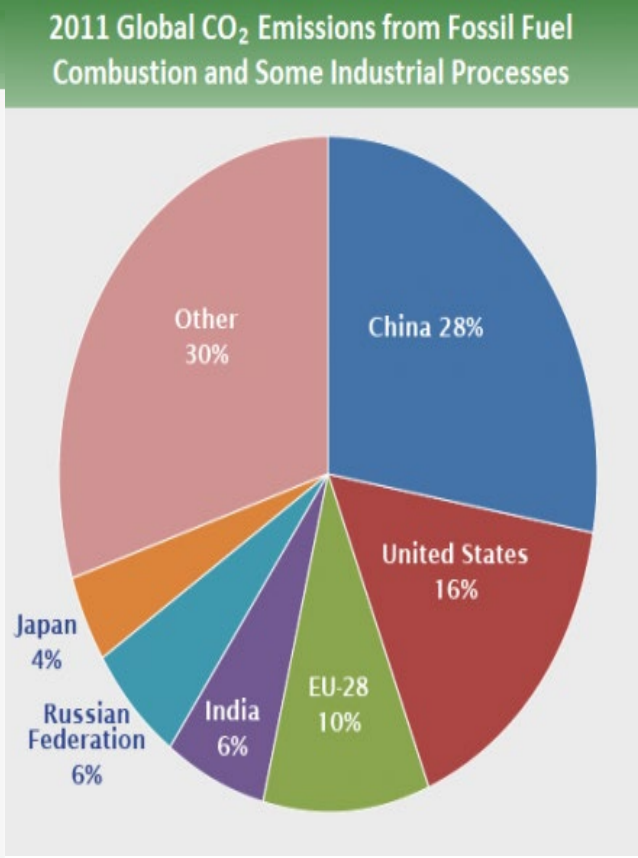
➢Recent studies have indicated that a 2 degrees increase in global temperature will affect agricultural productivity, particularly in the tropical regions(Kirtman et al. 2013; Dinesh et al. 2015).

➢The concentration of carbon dioxide has increased from 300 ppm to 405 ppm (Houghton et al. 1995; NOAA 2018).

Global Greenhouse Gas Emissions Data







Source: [IPCC (2014)](); **Source: Boden et al., 2015.**

Introduction

•Pigeonpea, is one of the most important grain legumes in India, East and southern Africa and the West Indies.

•Global area 7.033mha and production 4.89mt(FAO 2014) and In India, the area under Pigeonpea 5.39mha with production 4.60mt and average productivity 854kg/ha(DAC 2017)

•Nearly 300 species of insects are known which infest on pigeonpea crop at its various growth stages in the world (Lal and Singh, 1998).

•Pod borers caused 60 to 90 % loss, pod fly ranged from 14.3 to 46.6 % (Jaba et al 2017).

Losses due to Insect Pests in Grain Legumes

- Of the total yield gap of US$43.3 billion, diseases account for $6.68 billion, insect pests for $6.38 billion and weeds $3.02 billion.
- Cost of insecticides used for pest control: US$ 500 million

Country	Losses (US$ Millions)
Australia	250*
Africa	500*
Asia	2,000
Americas	2,000*
*Helicoverpa**	2,000
Grain legumes (25% loss)	**16,500**

Climate Change: Emerging Pest Problems in Pigeonpea

Perennial Pests

Emerging Pests

Perrenial and Emerging Pests in Chickpea

The Perennial Pests

Aphis craccivora

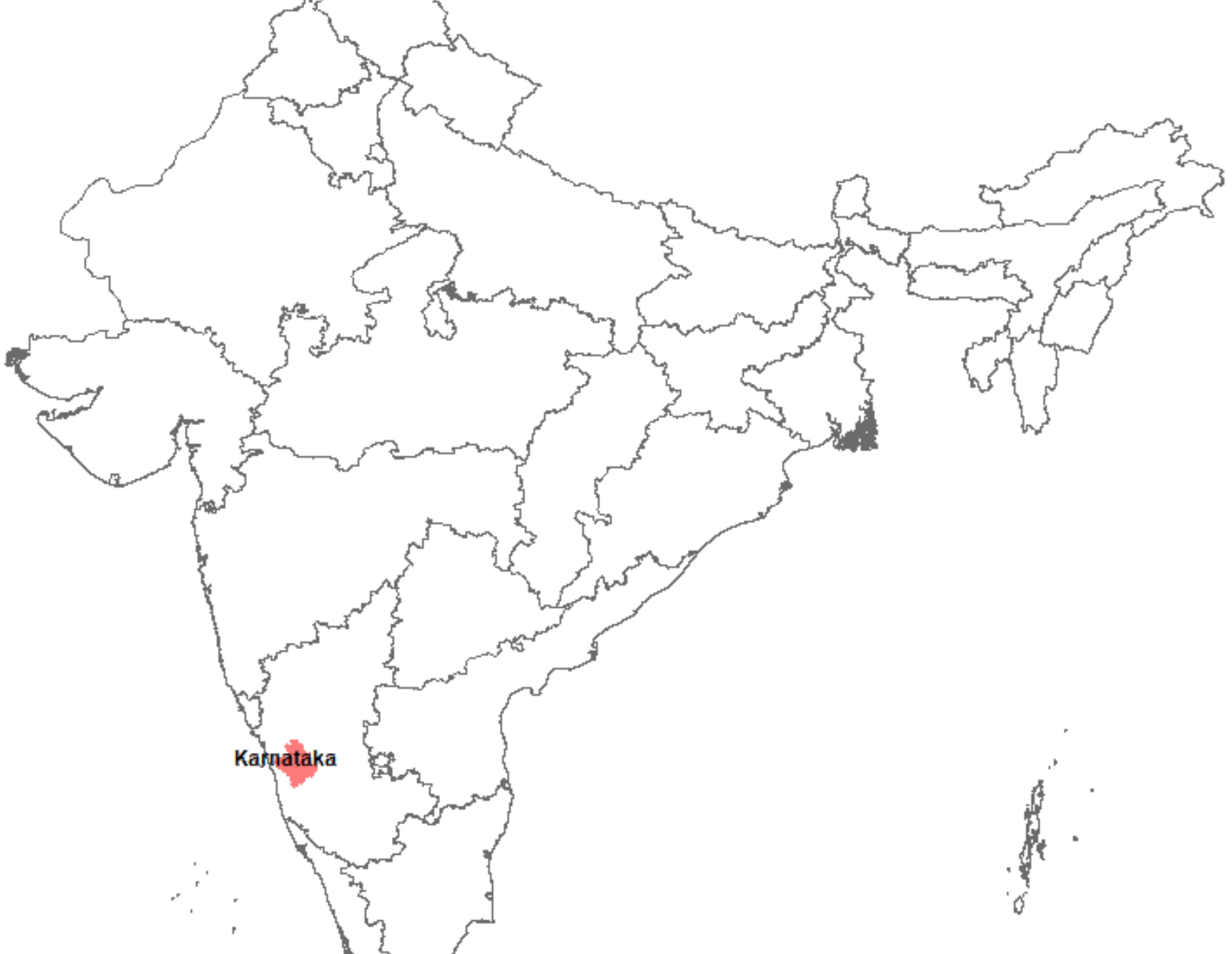
Helicoverpa

Bemisia tabaci

Spodoptera exigua

Bruchid

Mealy bug


Karnataka

Major pests of pigeonpea

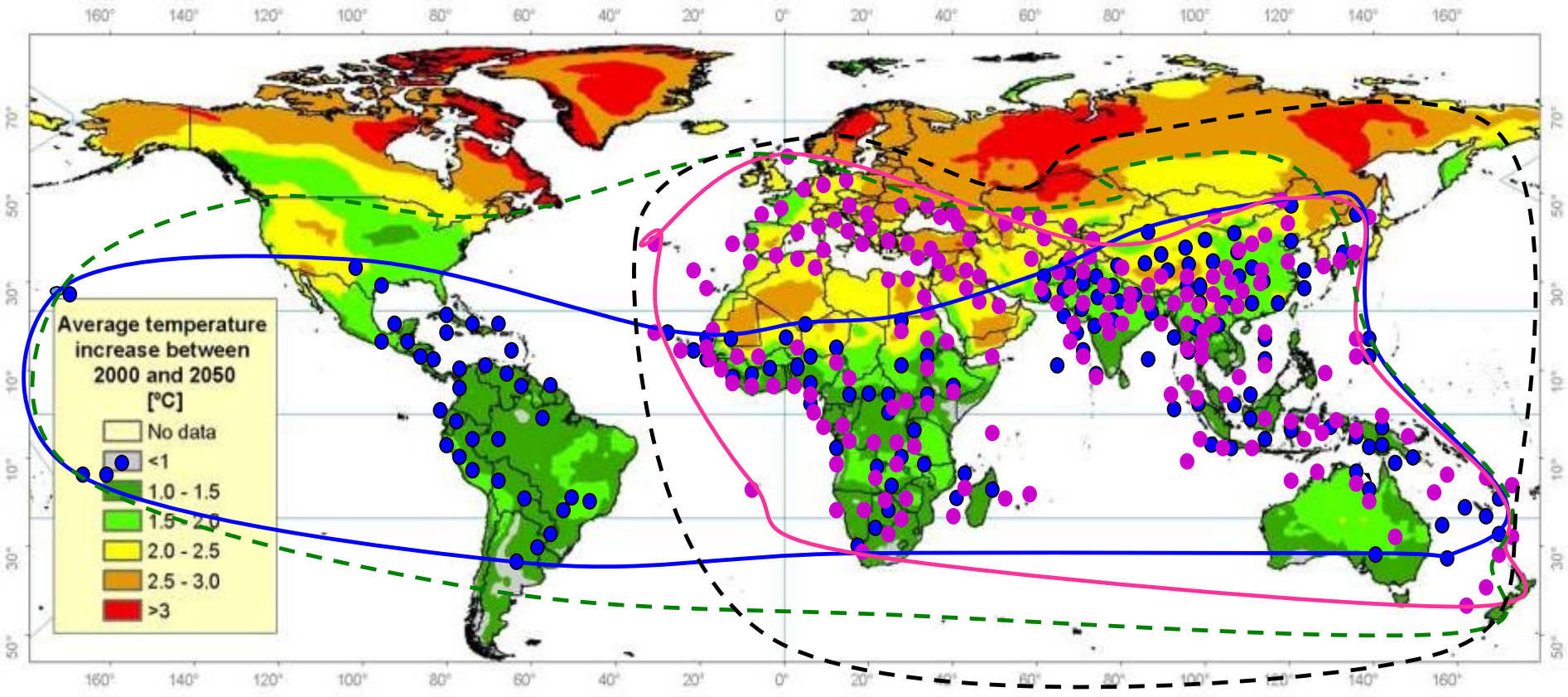
Common name	Entomological name	Plant parts damaged
Flower beetle	*Mylabris* spp.	Flower/pod
Spotted pod borer	*Maruca vitrata*	Pod
LeafWebber	*Pammene critica*	Leaf/Flower
Gram pod borer	*Helicoverpa armigera*	Pod
Plume moth	*Exelastis atomosa*	Pod
Blue butterfly	*Catochrysops cnejus*	Pod
Pod wasp	*Tanaostigmodes cajaninae*	Pod
Pod fly	*Melanagromyza obtusa*	Pod
Pod bug	*Clavigralla gibbosa*	Pod

Minor pests

Common name	Entomological name	Plant parts damaged
Leaf Roller	*Lobesia aeolopa*	Leaf
Leaf Roller Moth	*Glyphodes bivitralis*	leaf
Blue butterfly	*Lampides boeticus*	Flower/pod
Spiny pod borer	*Etiella zinckenella*	Pod
Pod weevil	*Apion clavipes*	Leaves, Flowers / Pod
Bud weevil	*Indozocladius asperulus*	Flower buds
Aphid	*Aphis craccivora*	Growing shoots
Scales	*Ceroplastodes cajani*	Stem
Mealybug	*Coccidohystrix insolita*	Leaves
Jassids	*Empoasca kerri*	Leaves
Red spider mite	*Schizotetranychus cajani* ``	Leaves
Eriophyid mite	*Aceria cajani*	Leaves, SMD

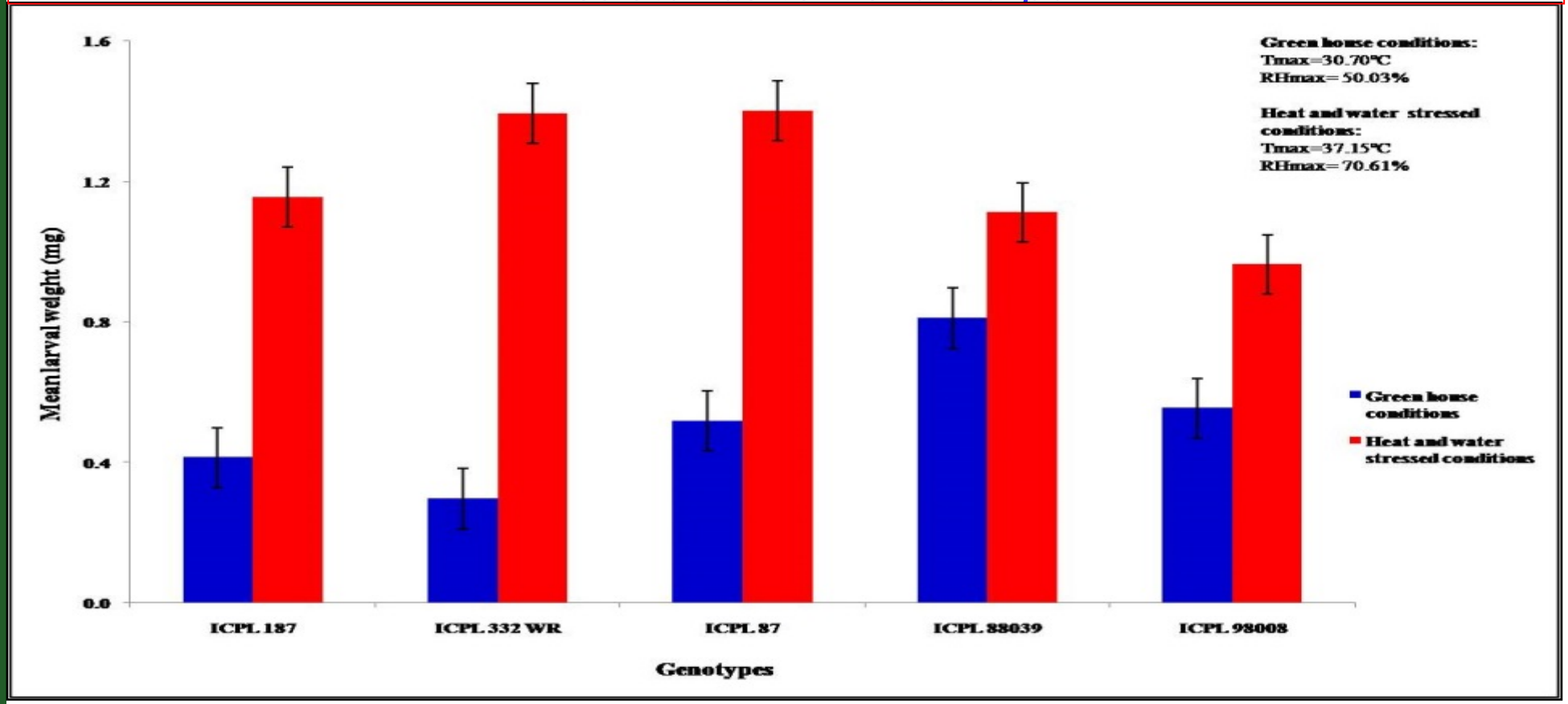
Climate Change and Geographical Distribution of Pests

Helicoverpa and *Maruca*



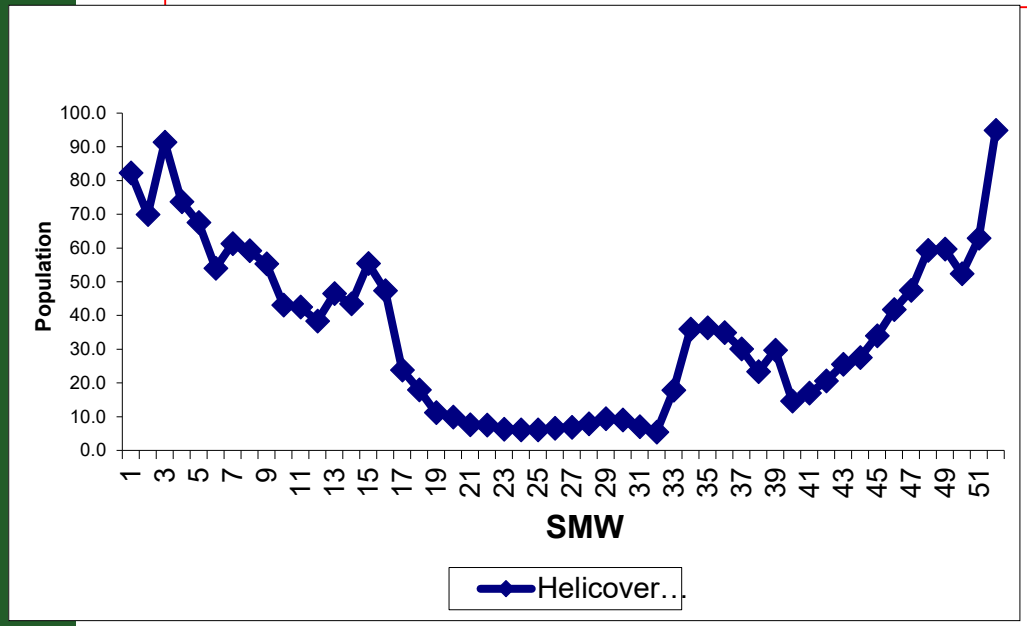
Climate change effects on geographical distribution of *pod borer, Helicoverpa armigera* (pink dots) and spotted pod borer, *Maruca vitrata* (blue dots). (Sharma , 2014)

Effect of Heat and Drought Stress in Pigeonpea on Expression of Resistance to *Helicoverpa*

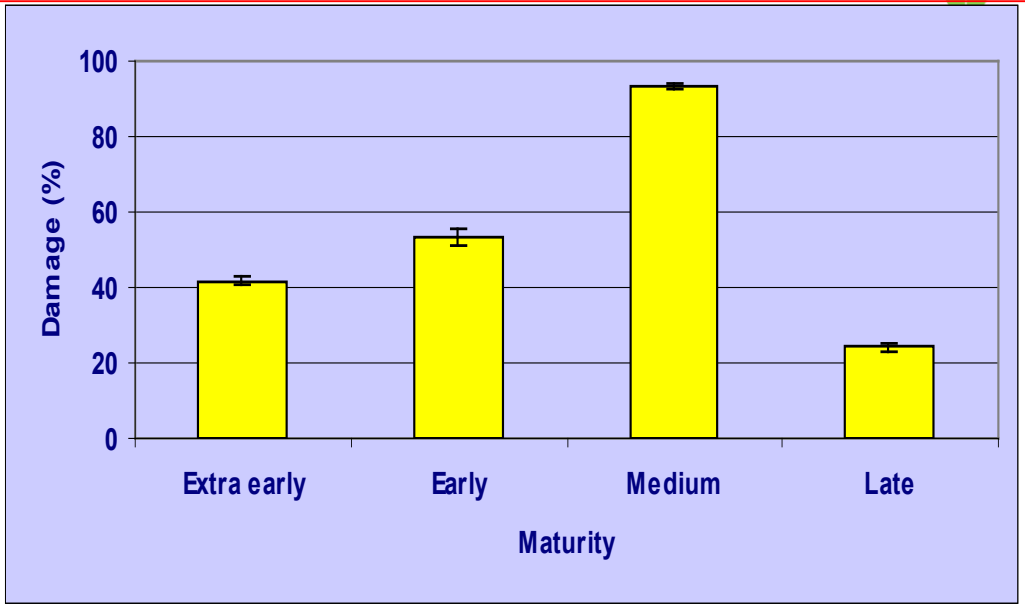


Weights of *H. armigera larvae* on different pigeonpea genotypes grown under greenhouse and heat and water stressed conditions.

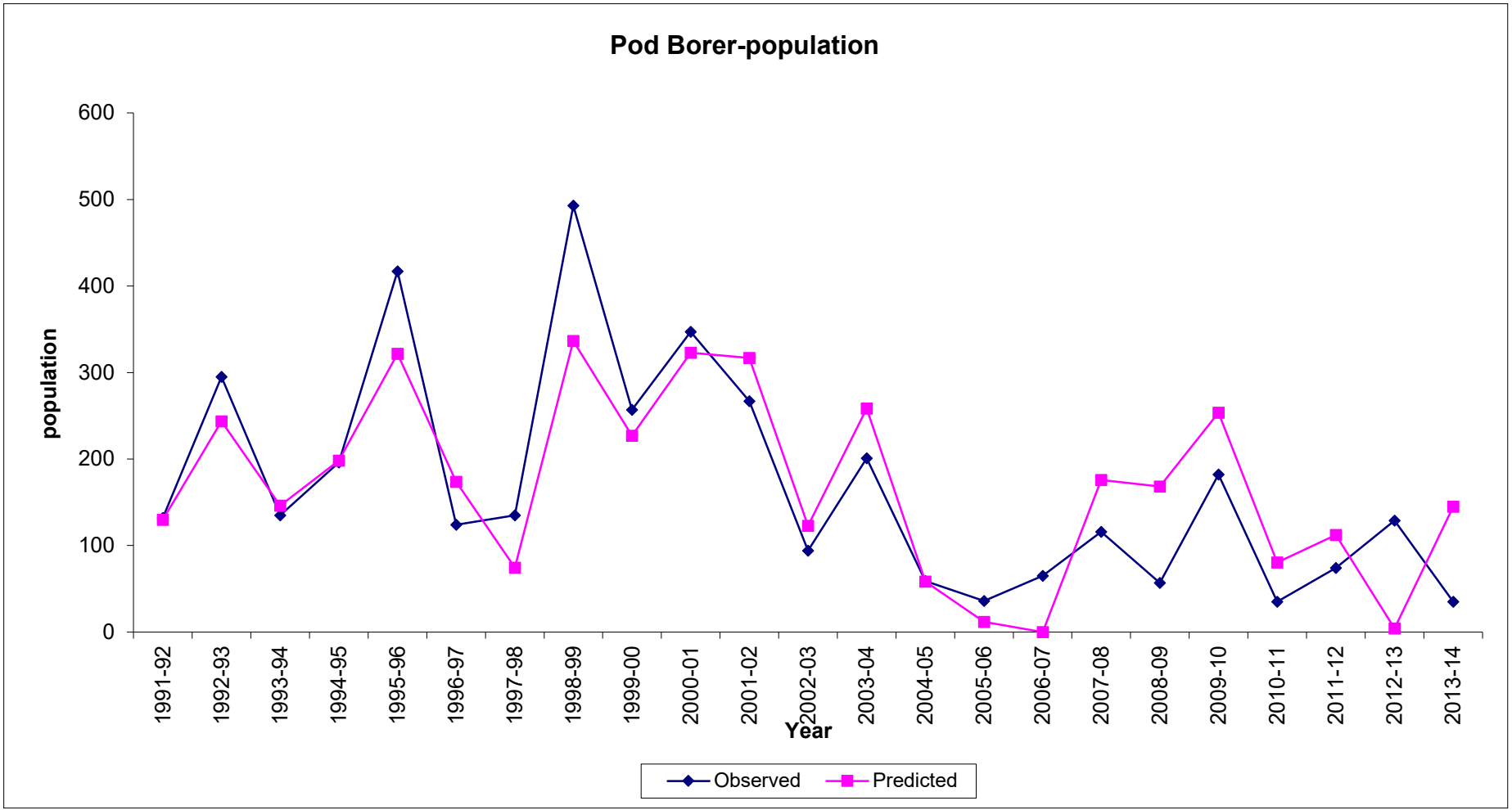
Population Dynamics of *Helicoverpa*



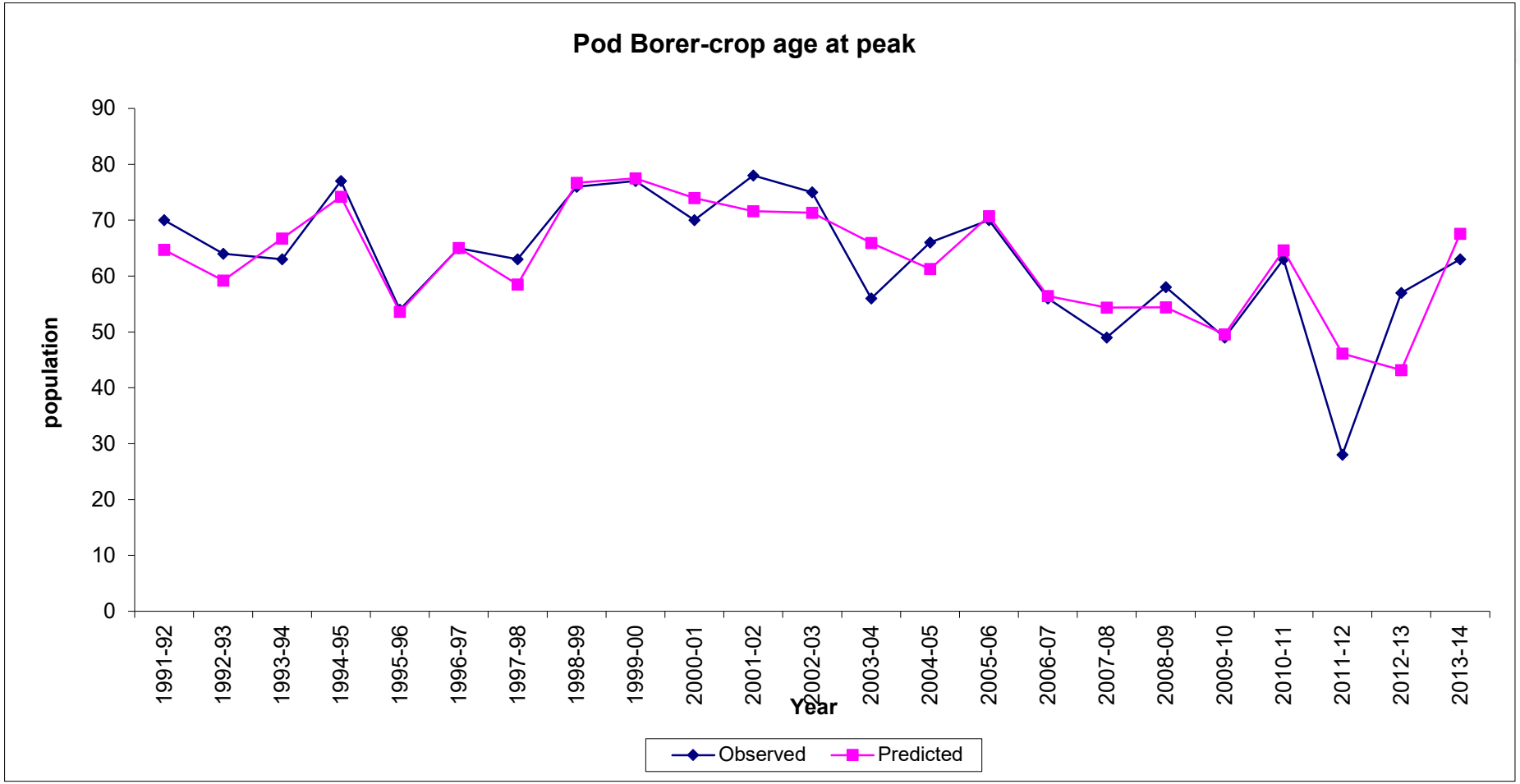
Pheromone trap data of *H.armigera* 1991-2017.



Variation in per cent of damage in varied plantings.

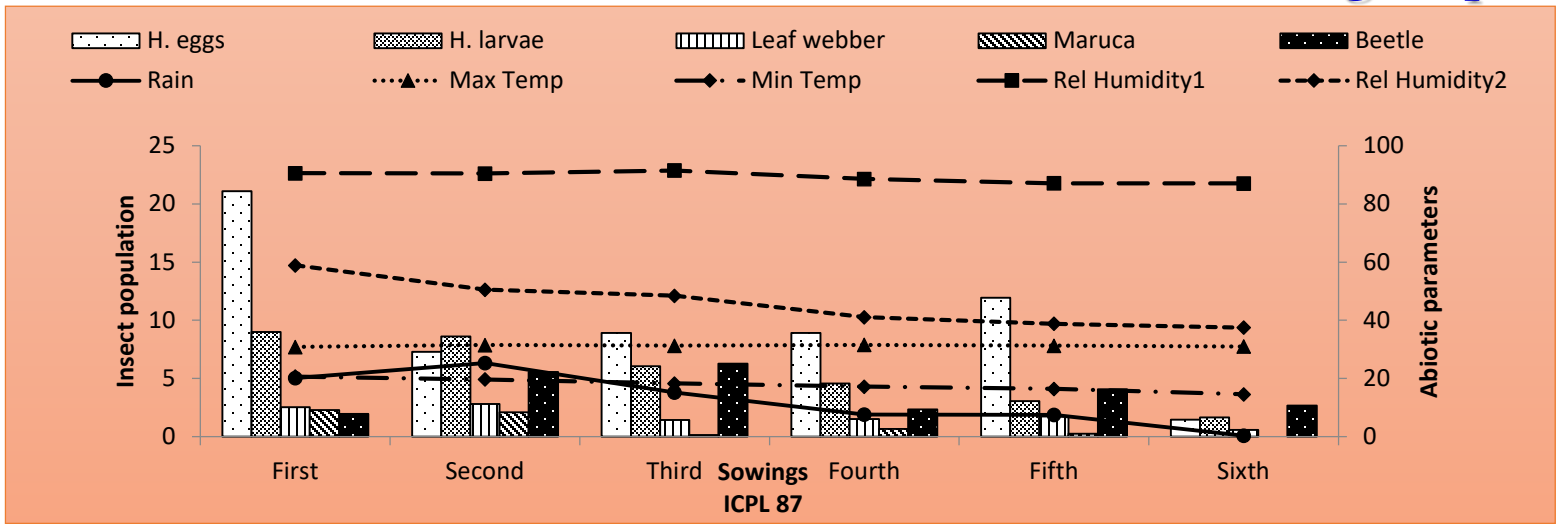


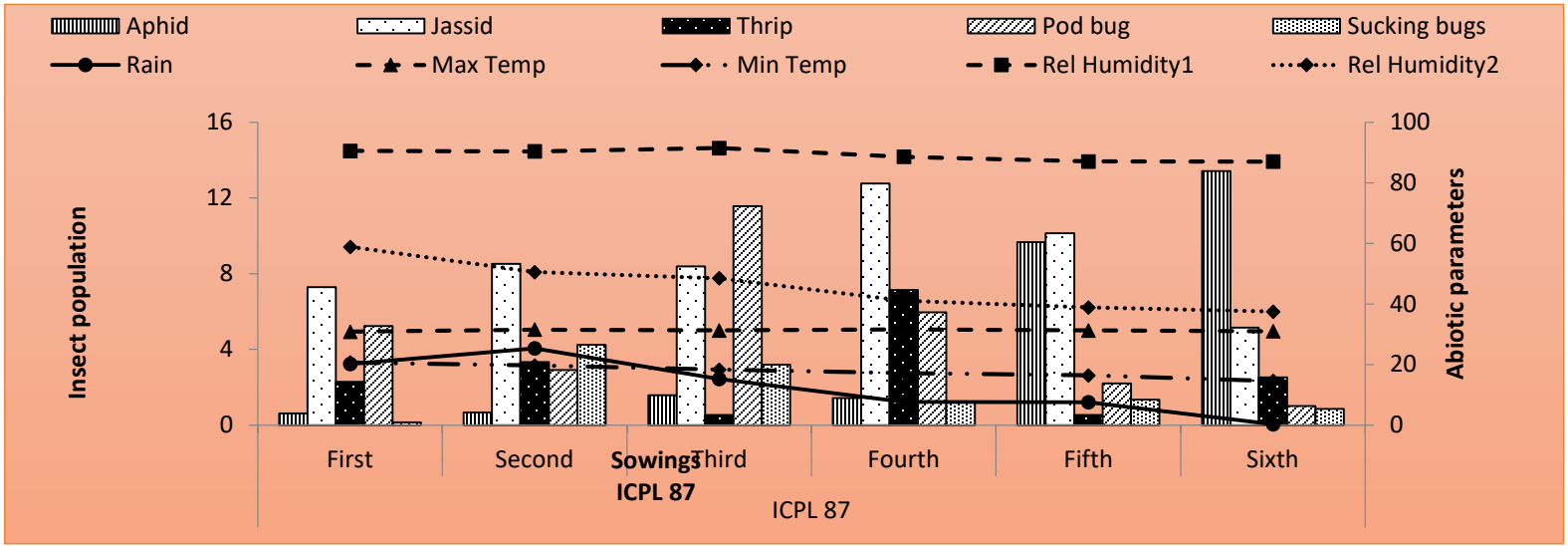
Incidence of *H. armigera* population

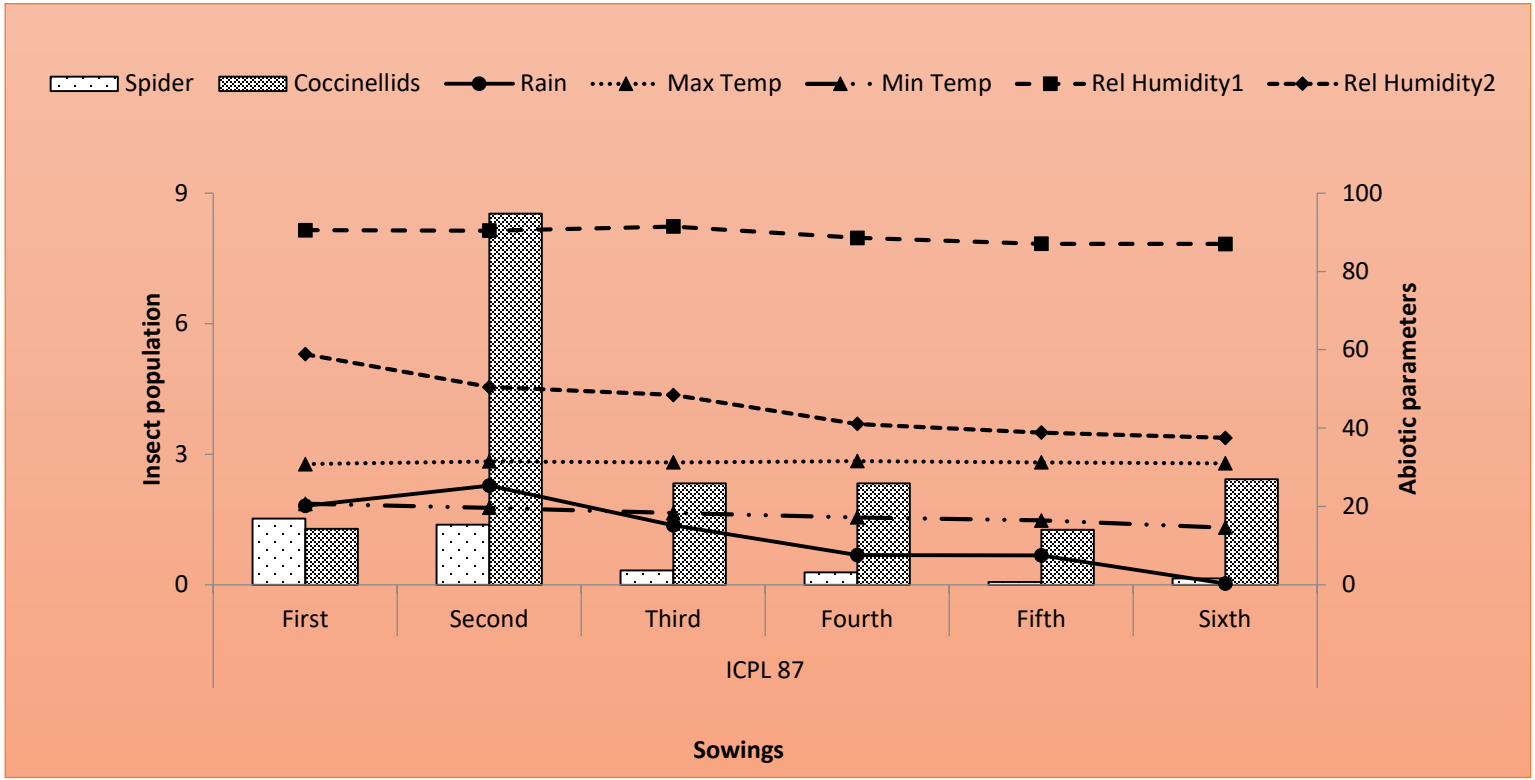


Incidence of *H. armigera* population at crop stage

Effect of Climatic Factors on Pest Incidence in Pigeonpea

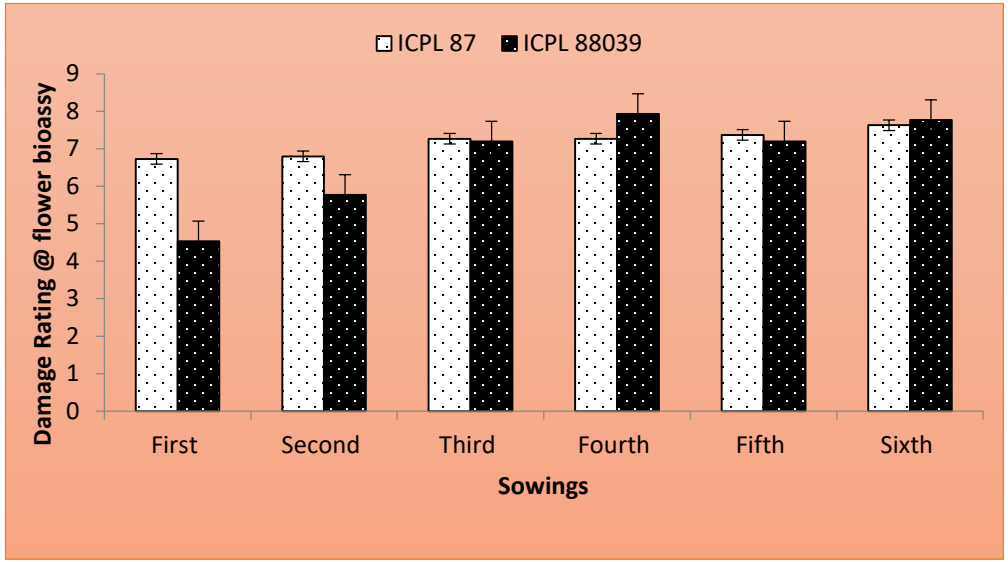


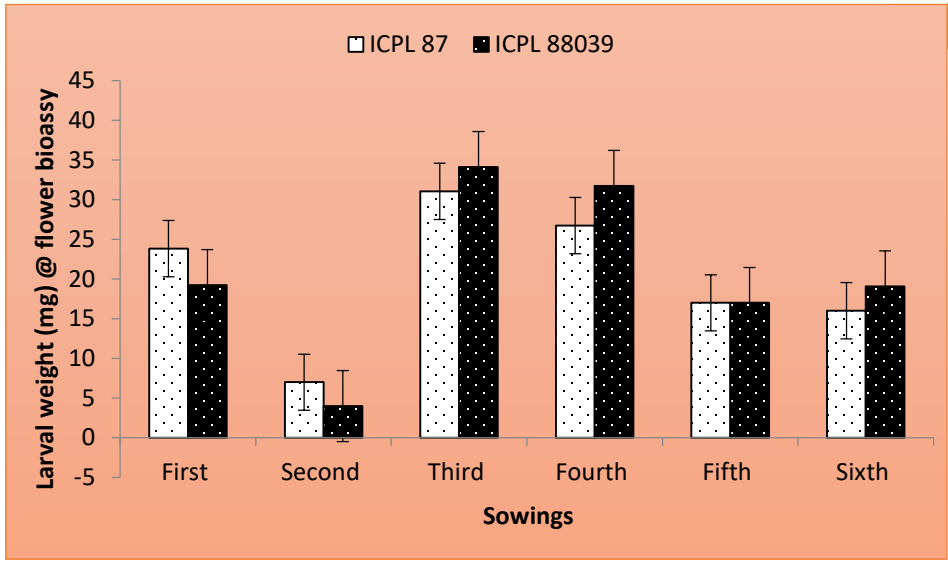


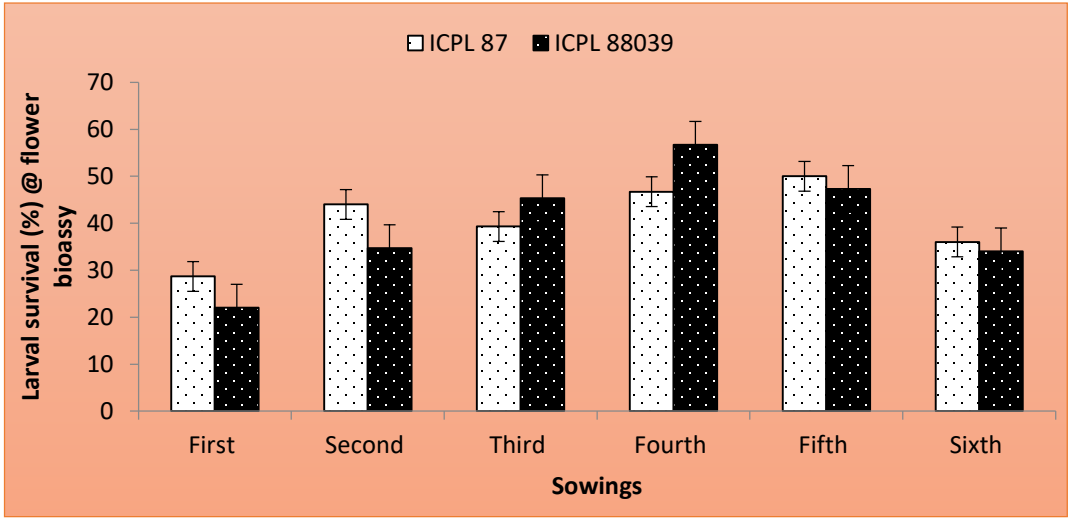


Effect of different plantings on the population natural enemies on ICPL 87

Effect of different sowing dates on host plant resistance of *H. amrigera*







Correlation coefficient (r) between pigeonpea pod borer and prevailing weather parameters during crop growing seasons

Pests	Rain (mm)	Evaporation (mm)	Max T	Min T	RH 1	RH 2	WV(kmph)	Solar (mj/m2)
H. eggs	-0.057	0.128	0.183	0.038	0.528**	-0.098	-0.272	0.274
H. larvae	-0.173	0.009	0.228	0.491**	0.135	-0.107	-0.176	0.234
Leaf Webber	0.071	0.139	0.449**	0.320	0.103	0.010	-0.504	0.533**
Maruca	0.059	0.108	0.172	0.156	0.100	0.071	-0.102	0.296
Beetle	0.306*	0.206	0.258	0.265	0.045	0.050	-0.365	0.306*
Aphid	-0.155	-0.110	0.263	-0.086	0.444*	-0.189	0.103	-0.222
Jassid	-0.178	-0.036	0.082	0.036	0.198	-0.120	-0.096	0.056
Thrip	-0.055	0.095	0.041	-0.097	-0.132	-0.216	-0.093	0.080
Pod bug	-0.165	0.081	0.421**	-0.039	0.198	-0.244	0.109	0.041
Sucking bugs	-0.157	-0.030	0.122	-0.010	0.044	-0.155	-0.003	0.023
Spider	0.191	-0.011	0.259	0.219	0.075	0.046	-0.294	0.230
Coccinellids	-0.146	-0.149	0.206	-0.045	0.188	-0.133	0.045	-0.162
Leaf Minor	0.020	0.154	0.241	0.354*	0.097	0.199	-306.0	0.368*
Blister beetle	0.189	-0.051	0.123	0.237	0.063	0.171	-0.072	0.164
Mealybug	-0.042	-0.060	0.085	0.121	0.169	0.038	-0.125	0.059

Conclusions

- Temperature, Rain fall and RH showed a considerable effect on insect incidence and arthropod diversity across planting dates in pigeonpea.

- Incidence of *M. vitrata* declined in crops planted late planting

- Cropping patterns, climate change has resulted in emergence of serious pests such as spotted pod borer, *M. vitrata*, pod fly, pod sucking bug, *Clavigralla* spp. and mealy bug, *Drepanococcus cajani*

- Heavy rains during October - November often result in outbreaks of *H. armigera* and *M. vitrata* in southern India, while early warming of weather in North India (3 – 5 °C higher than the normal in March) result in heavy *H. armigera* damage in pigeonpea and chickpea in North India

Future prospects

- Development of forecast models for *H. armigera* and *M. vitrata* of pigeonpea

- There is need to develop simulation, life cycle model to predict the likely changes in population dynamics of *H. armigera and M. vitrata* under global warming and climate change scenario

Remember, without farmers there will be no food, and without food there will be no life.

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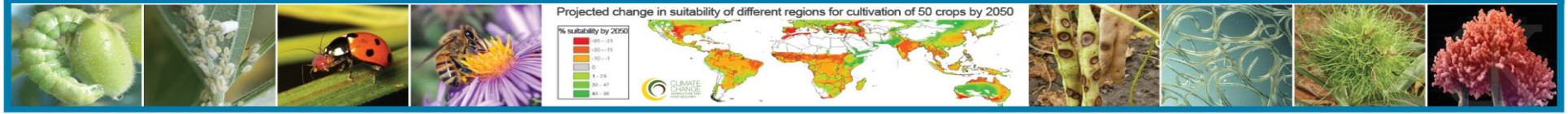
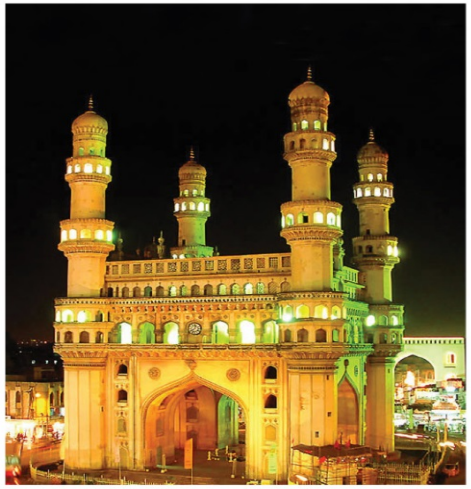


Crop Protection to Outsmart Climate Change for Food Security and Environmental Conservation



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THANKS

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