PART - I

A) Survey of gum yielding plants

1) Gum yielding plants from Marathwada

   Plant gum was collected from different districts of Marathwada region like Aurangabad, Jalna, Parbhani, Beed, Nanded, Osmanabad, Hingoli and Latur. In this region there are numerous gum yielding plants are present and they are belonging to different families predominantly Fabaceae, Ceasalpenaceae, Burseraceae, Celasteraceae, Anacardiaceae, Moringaceae, Sterculaceae and Compretaceae, etc. Some of the gum yielding plants present in Marathwada region are summarised in table 1.

2) Occurrence of gum yielding plants in different districts of Marathwada

   The gum yielding plants from different district of Marathwada is given in table 2. By extensive survey and collection of gums it was found that all gum yielding plants are available in all localities of Marathwada.

3) Collection of gum from different part of plants

   In order to know the gum yielding potential of different part of plants like root, stem/bark, leaves, flower, seed/fruits were studied and the results are summarised in table 3.
It was interesting to note that as mostly plant gum is commonly occurred from the stem or bark of the plant. Most of the plant shows occurrence of gum for the plant bark / stem. However it is observed that along with bark / stem after part also showed occurrence of gum. The gum is also occurred from root in case of *Azadirachta indica*, *Ficus amplissima* and *Ficus benghalensis* and from fruit / seed in case of *Manikara zapota* and *Moringa oleifera*. However gum do not occurs in leaves and flowers.

4) **Selected gum yielding plants**

Totally 32 gum yielding plants were recorded out of which ten plants were selected for further study on the basis of its maximum gum yielding potential i.e. as recorded in table 4, Plate 2.

The plants selected for study were *Acacia arabica*, *Acacia chundra*, *Azadirachta indica*, *Boswellia serrata*, *Butea monosperma*, *Cassine albens*, *Mangifera indica*, *Moringa oleifera*, *Sterculia urens*, *Terminalia arjuna*. The selected plants were belonging from different families particularly *Fabaceae*, *Meliceae*, *Burseraceae*, *Celasteraceae*, *Anacaridaceae*, *Moringaceae*, *Sterculaceae* and *Combretaceae*.

5) **Seasonal variation in production of gum in plants**

The gum yielding potential of selected plants was studied in different seasons particularly winter, summer and monsoon and the results are summarized in table 5.

It is clear from the table that all the selected plants yielded maximum gum in winter season followed by summer and then monsoon. In winter
season *Sterculia urens* yielded maximum gum i.e. 300 gm followed by *Azadirachta indica, Mangifera indica, Moringa oleifera, Cassine albens* which yielded 250 gm of gum in winter season i.e. by means of artificial injury methods. *Acacia arabica* was the only plant which yielded only 200 gm of gum.

6) **Occurrence of gums after artificial injury**

In monsoon season the selected plants yielded very low amount of gum i.e. between 25 to 30 gm only. After studying the gum yielding potential in different seasons the experiment was conducted to know the effect of days on gum production and the results are summarised in table 6, Fig. 1 and Plate 3.

It is clear from the results that all the selected plants did not yield gum on the 1\textsuperscript{st} day of artificial injury but the production of gum was increased as days passes. The quantity of gum produced by selected plants was in between 10 to 15 gram after 15 days. Whereas it was in between 90 to 150 gm after 30 days. The selected plants produced maximum gum after 60 days. It was in between the range of 200 to 300 grams. The maximum gum production was recorded in *Boswellia serrata* that was 15 gm, 150 gm, 300 gm after 15, 30 and 60 days. Whereas it was very low in *Moringa oleifera* and *Butea monosperma*. i.e 10, 100 and 180 grams for 15, 30 and 60 days respectively.
B) **Physical properties of plant gum**

Physical properties viz., pH, colour, taste, smell, viscosity, harness, state, colloidal nature, moisture content and dry matter of gum were studied and results are given in table 7 to 12.

1) **Change in pH of gum at different age**

It is clear from the table 7 and fig. 2 that the pH of freshly collected gum was in the range of 7.6 to 8.5. The 7.6 pH was that of *Cassine albens*, 7.7 for *Mangifera indica*, *Sterculia urens*, 7.9 for *Acacia chundra* and *Butea monosperma*, 8.0 for *Acacia arabica* and *Moringa oleifera*, 8.1 for *Azadirachta indica* and *Boswellia serrata*, 8.5 for *Terminalia arjuna* when the pH were studied after 15 days, 30 days and 60 days. There was found slight variation from the 1st day results in some plants. In *Cassine albens*, *Terminalia arjuna* there was reduction in pH and in *Butea monosperma*, *Sterculia urens* gum there was no change whereas in remaining plants the pH was found to be increased.

2) **Change in colour of gum at different age**

It is clear from the table 8 and plate 6 that the freshly collected gum of *Acacia arabica*, *Acacia chundra*, *Azadirachta indica* was yellowish red while that of *Butea monosperma*, *Mangifera indica*, *Moringa oleifera*, was red. Gum of *Boswellia serrata*, *Stercularia urens* was white in colour. *Cassine albens* and *Terminalia arjuna* gum were black and pale yellow in colour respectively. There was change in colour of gum after storage for the
plants like *Acacia arabica*, *Acacia chundra* and *Azadirachta indica*. There was no change in colour of gum of remaining plants.

3) **Taste and smell of gum**

The results of taste and smell of gum were recorded in table 9. It is clear from the results that the test of most of plants particularly *Azadirachta indica*, *Butea monosperma*, *Cassine albens*, *Mangifera indica*, *Moringa oleifera* and *Terminalia arjuna* were bitter whereas test of *Acacia arabica*, *Acacia chundra*, *Boswellia serrata*, *Sterculia urens* gum was sweet. *Acacia arabica*, *Acacia chundra*, *Azadirachta indica*, *Mangifera indica* and *Moringa oleifera* gum was pungent and it was aromatic in smell for the remaining plants.

4) **Physical status of gum**

It is clear from the table 10 that the gum of *Acacia arabica*, *Acaica chundra*, *Azadirachta indica*, *Butea monosperma*, *Cassine albens*, *Mangifera indica*, *Sterculia urens*, *Terminalia arjuna* were found to be viscous and it was semi viscous for the plants *Boswellia serrata*, *Moringa oleifera*. The gum of *Acacia arabia*, *Acacia chundra*, *Azadirachta indica*, *Butea monosperma*, *Cassine albens*, *Terminalia arjuna* was found to be hard. The gum of *Boswellia serrata*, *Mangifera indica*, *Moringa oleifera*, *Sterculia urens* was found soft. The gum of *Mangifera indica* and *Moringa oleifera* was found semi solid state and remaining plants were found to be in solid state.
5) **Change in colloidal nature of gum**

Colloidal nature of gum was studied at different time and results are summarised in table 11. It was found that all tested plant gums were colloidal in nature for 15, 30, 45 and 60 minutes.

The colloidal nature of *Acacia chundra*, *Boswellia serrata* and *Cassine albens*, *Terminalia arjuna* was increased with increase in time whereas, colloidal nature of *Acacia arabica*, *Butea monosperma* was almost remains constant.

6) **Dry matter and moisture content of gum**

Dry matter and moisture content of selected plants gum were studied and results were recorded in table 12 and fig. 3. It is clear from the results that the percentage of dry matter was in between 98.57 % to 98.68 % and the moisture content was in between 1:30 to 1:43 %.

Moisture content of gum *Mangifera indica* and *Moringa oleifera* was found to the maximum whereas *S. urens* showed maximum percentage of dry matter.

7) **Solubility of gum in different solvents**

The solubility of gum was checked in polar and non polar solvents and results are summarised in table 13 and it is clear that the most of the gums are soluble in water and partially soluble in acetone whereas it was insoluble in remaining solvents.
C) Chemical properties of gum

In order to investigate the important chemical properties and presence of some important chemicals in plant gum. The gum were tested for different chemical properties like crude fibre, fat, nitrogen, crude protein, non reducing, total sugar, phenols, alkaloids, solubility and tannins. The results of conducted experiments are summarised in table 14 to 17.

1) Crude fibre and fat content of gum

It is clear from table 14 and fig. 4 that the crude fibre of gum was 1.51 in of *Terminalia arjuna*, 4.46 in *Cassine albens*, 6.92 in *Butea monosperma*, 7.64 in *Mangifera indica*, 7.89 in *Moringa oleifera*, 7.98 in *Acacia arabica*, 8.80 in *Acacia chundra*, 9.12 in *Azadirachta indica*, 9.29 for *Sterculia urens* and 9.39 for *Boswellia serrata*. The highest fat content of gum was observed 1.19 in *Acacia arabica*, 1.17 in *Terminalia arjuna* and 0.98 in *Acacia chundra* and the lowest fat content of gum was found 0.5 in *Azadirachta indica*, 0.4 in *Butea monosperma* and 0.3 in *Cassine albens* were recorded.

2) Crude protein and nitrogen content of gum

It is clear from the table 15 and fig. 5 that the crude protein of gum was found in between the range of 0.250 % and 0.437 % and percentage of nitrogen content was in between 0.04 % and 0.07 %. Highest percentage of nitrogen was found in gum of *Acacia arabica*, *Acacia chundra* and *Terminalia arjuna*. *Acacia arabica* gum contain more protein while lowest protein and nitrogen content was reported in *Butea monosperma* gum.
3) **Sugar content of gum**

The results of reducing sugar was in between the range of 0.048 % to 0.061 % and the percent non reducing sugar was in the range of 0.347 % to 0.643 % and percentage of total sugar was 0.4 % to 0.7 % as indicated in table 16 and fig. 6. Maximum reducing sugar, non-reducing sugar and total sugar content was observed in gum of *Terminalia arjuna*, *Sterculia urens* and *Cassine albens* and *Sterculia urens*.

4) **Qualitative analysis of chemical compounds**

The qualitative analysis of plant gum was carried out for the important chemical compounds like phenols, alkaloids, tannins and the results of experiments are summarised in table no.17.

It is clear from the result that the gum of selected plants showed the presence of phenols. The alkaloids were present in the gum of *Acacia chundra*, *Acacia arabica*, *Azadirachta indica* and *Moringa oleifera* whereas gum of plant like *Boswellia serrata*, *Butea monosperma*, *Cassine albens*, *Mangifera indica*, *Sterculia urens* and *Terminalia arjuna* were found to be devoid of alkaloids. The tannins were present in the gum of *Acacia arabica*, *Acacia chundra*, *Boswellia serrata*, *Cassine albens*, *Moringa oleifera*, *Sterculia urens*, *Terminalia arjuna* whereas gum of plants like *Azadirachta indica*, *Butea monosperma*, *Mangifera indica* were found devoid of tannins.
A) Bioactivity of plants gum against important fungi

In order to investigate the bioactivity of gum of selected plants against the economically important fungi like *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Curvularia pellescens*, *Fusarium equiseti*, *Fusarium oxysporum*, *Macrophomina phaseolina*, *Penicillium digitatum*, *Penicillium chrysogenum* and *Rhizopus stolonifer*. The experiments were carried out by using different concentrations of plant gum i.e. 1%, 5%, 10%. The results of bioactivity of gum are summarised in table 18 to 27.

1) Bioactivity of *Acacia arabica* plant gum

It is clear from table 18 and fig. 7 that the gum *Acacia arabica* was found to promote the growth of fungi like *Alternaria alternata*, *Aspergillus niger* as the function of concentration of gum. Whereas the growth of fungi like *Curvularia lunata*, *Fusarium equiseti*, *Fusarium oxysporum*, *Macrophomina phaseolina*, *Penicillium digitatum* and *Penicillium chrysogenum* were found to be inhibited by the 1% gum of *Acacia arabica*. But on the contrary the concentration of gum increased to level of 5% and 10%, the increase in dry mycelium weight of these fungi were reported. The *Rhizopus stolonifer* was found to be suppressed at 10% concentration.

2) Bioactivity of *Acacia chundra* plant gum

It is clear from table 19 and fig. 8 that the gum of *Acacia chundra* was found to promote the growth of fungi like *Macrophomina phaseolina*...
and \textit{Penicillium chrysogenum} with the increased concentration of gum. On the other hand the fungi like \textit{Alternaria alternata}, \textit{Aspergillus niger}, \textit{Curvularia lunata}, \textit{Fusarium equiseti}, \textit{Fusarium oxysporum} and \textit{Rhizopus stolonifer} were found to be inhibited at 1\% concentration of gum. But at 5\% concentration the fungi like \textit{Alternaria alternata}, \textit{Aspergillus niger}, \textit{Curvularia pellecence}, \textit{Fusarium equiseti} and \textit{Rhizopus stolonifer} showed the increased in dry mycelial weight. At 10\% concentration all fungi except \textit{Curvularia pellecence} and \textit{Penicillium digitatum} showed increase in dry mycelium weight.

3) \textbf{Bioactivity of \textit{Azadirachta indica} plant gum}

The gum of \textit{Azadirachta indica} were tested for its bioactivity against selected fungi and it is clear that table 20 and fig. 9 that \textit{Azadirachta indica} retarded the growth of \textit{Curvularia lunata} and \textit{Fusarium equiseti} at 1\% concentration as compared to the control. On the other hand all remaining fungi showed increase in dry mycelium weight at 1\% concentration. At 5\% concentration the \textit{Curvularia pellecence}, \textit{Fusarium equiseti}, \textit{Fusarium oxysporum} and \textit{Rhizopus stolonifer} were found to be inhibited by 5\% concentration of gum. Whereas remaining fungi showed increase in dry mycelium weight at 5\% concentration of gum. At 10\% concentration the \textit{Fusarium oxysporum} and \textit{Rhizopus stolonifer} were the only two fungi which showed the reduction in dry mycelium weight as compared to control.
4) **Bioactivity of *Boswellia serrata* plant gum**

It is clear from the table 21 and fig. 10 that the gum of *Boswellia serrata* at 1% concentration was found to promote the growth of *Alternaria alternata, Fusarium oxysporum, Penicillium chrysogenum* and on the other hand it was found to promote the growth *Aspergillus niger, Curvularia lunata, Curvularia pellecence, Fusarium equiseti, Macrophomina phaseolina, Penicillium digitatum, Rhizopus stolonifer* at 1% concentration. The gum of *Boswellia serrata* at 5% concentration was found to inhibit the growth of fungi like *Aspergillus niger, Fusarium equiseti, Macrophomina phaseolina* and *Rhizopus stolonifer*. At 10% concentration the gum *Boswellia serrata* was found to promote the growth of all selected fungi.

5) **Bioactivity of *Butea monosperma* plant gum**

The gum of *Butea monosperma* were tested for its bioactivity against selected fungi and it is clear from table 22 and fig. 11 that *Butea monosperma* retarded growth of *Curvularia lunata, Curvularia pellecence, Fusarium oxysporum, Macrophomina phaseolina, Penicillium chrysogenum* and on the other hand it was found to promote the growth of *Alternaria alternata, Aspergillus niger, Fusarium equiseti, Penicillium digitatum, Rhizopus stolonifer* at 1% concentration. The gum of *Butea monosperma* at 5% concentration was found to inhibit the growth of fungi like *Fusarium equiseti, Macrophomina phaseolina, Penicillium digitatum* and *Rhizopus stolonifer* whereas at 10% concentration the gum *Butea monosperma* was
found to promote the dry mycelial weight except *Curvularia pellecence* and *Fusarium oxysporum*.

6) **Bioactivity of Cassine albens plant gum**

It is clear from the table 23 and fig. 12 that the gum of *Cassine albens* was found to promote the growth of *Alternaria alternata*, *Aspergillus niger*, *Fusarium equiseti*, *Fusarium oxysporum*, *Macrophomina phaseolina* and *Rhizopus stolonifer* as the function of concentration of gum whereas *Curvularia lunata*, *Curvularia pellecence*, *Penicillium digitatum* and *Penicillium chrysogenum* were found to be inhibited by the 1% concentration of gum.

Mycelium dry weight of *Fusarium oxysporum*, *Macrophomina phaseolina*, *Rhizopus stolonifer* was retarded at 5% *Cassine albens* gum whereas remaining fungi showed increased dry mycelial weight at 5% concentration of gum. At 10% concentration the *Fusarium oxysporum* were the only one fungi which showed the reduction in dry mycelial weight as compared to control.

7) **Bioactivity of Mangifera indica plant gum**

It is clear from the table 24 and fig. 13 the gum of *Mangifera indica* was found to promote the growth of *Alternaria alternata*, *Aspergillus niger*, *Fusarium oxysporum*, *Macrophomina phaseolina* and *Penicillium chrysogenum*, as the function of concentration of gum whereas the fungi like *Curvularia lunata*, *Curvularia pellecence*, *Fusarium equiseti*, *Penicillium digitatum* and *Rhizopus stolonifer* were showed increased in dry
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mycelial weight at 1% concentration. As compared to control at 5% concentration *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Fusarium equiseti*, *Macrophomina phaseolina*, *Penicillium digitatum* and *Penicillium chrysogenum* were found to be inhibited by 5% concentration of gum. Whereas remaining fungi showed increased dry mycelial weight at 5% concentration of gum. At 10% concentration the *Aspergillus niger*, *Macrophomina phaseolina*, *Penicillium chrysogenum* were the only three fungi which showed the reduction in dry mycelial weight as compared to control.

8) **Bioactivity of *Moringa oleifera* plant gum**

The gum of *Moringa oleifera* were tested for its bioactivity against selected fungi and it is clear from table 25 and fig. 14, that the fungi like *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Curvularia pellecence*, *Macrophomina phaseolina*, *Rhizopus stolonifer* were suppressed and on the other hand it was found to promote the growth of fungi like *Fusarium equiseti*, *Fusarium oxysporum*, *Penicillium digitatum*, *Penicillium chrysogenum* at 1% concentration. The gum of *Moringa oleifera* at 5% concentration was found to inhibit the growth of fungi like *Aspergillus niger*, *Curvularia pellecence*, *Fusarium equiseti*, *Macrophomina phaseolina*, *Penicillium digitatum*, *Penicillium chrysogenum*, *Rhizopus stolonifer*. At 10% concentration the gum of *Moringa oleifera* was found to increase dry mycelial weight of all fungi except *Alternaria alternata*. 
9) **Bioactivity of Sterculia urens plant gum**

It is clear from table 26 and fig. 15 that the gum of *Sterculia urens* was found to promote the growth of fungi like *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Fusarium equiseti*, *Fusarium oxysporum*, *Macrophomina phaseolina*, *Penicillium digitatum*, *Penicillium chrysogenum* and *Rhizopus stolonifer* as the function of concentration of gum. Whereas *Curvularia pellecence* was found to be inhibited by the 1% concentration of gum. At 5% concentration it was found to inhibit the growth of fungi like *Curvularia lunata*, *Curvularia pellecence*, *Rhizopus stolonifer*. At 10% concentration the gum of *Sterculia urens* was found all fungi except was only one fungi like *Curvularia pellecence* showed increasing dry mycelial weight.

10) **Bioactivity of Terminalia arjuna plant gum**

The gum of *Terminalia arjuna* were tested for its bioactivity against selected fungi and it is clear that table 27 and fig. 16 that the fungi like *Curvularia pellecence*, *Fusarium equiseti*, *Penicillium chrysogenum* were retarded and on the other hand it was found to promote the growth of fungi like *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Fusarium oxysporum*, *Macrophomina phaseolina*, *Penicillium digitatum*, *Rhizopus stolonifer* at 1% concentration of gum. The gum of *Terminalia arjuna* at 5% concentration was found to inhibit the growth of fungi like *Curvularia pellecence*, *Fusarium equiseti*, *Penicillium chrysogenum* and remaining fungi showed the increased in dry mycelial weight as compared to control.
At 10% concentration the gum of *Terminalia arjuna* was found to promote the growth of fungi except *Curvularia pellecence* and *Penicillium chrysogenum*.

**B) Bioactivity of plant gum against plant pathogenic bacteria**

In order to investigate the bio-potency of selected plant gum it was tested against the plant pathogenic bacteria viz. *Pseudomonas Isolate-I*, *Pseudomonas Isolate-II*, *Xanthomonas pv-compestris* and *Xanthomonas pv-Mangifera*. It is clear from the table 28 that the gum of all selected plants found to show the antibacterial activity against the taste bacteria except the gum of *Mangifera indica*, *Moringa oleifera*. The gum of *Acacia arabica* and *Acacia chundra* was found to show the highest antibacterial activity i.e. 14mm, 12 mm, 13mm, 16mm, 14mm, 12mm against Pseudomonas isolate, IP isolate II, *X. compestris*, *X. Mangifera*, respectively.

The least activity among the tested gum was showed by the gum of *Butea monosperma* and *Terminalia arjuna*.

**C) Effect of gum on hydrolytic enzyme action**

**1) Effect of gum on amylase activity**

Effect of gum 1% concentration on amylase activity of *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Curvularia pellecence*, *Fusarium equiseti*, *Fusarium oxysporum*, *Macrophomina phaseolina*, *Penicillium digitatum*, *Penicillium chrysogenum* and *Rhizopus stolonifer* were studied and results are given in table 29 and plate 9.
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It was found that *Acacia arabica* gum inhibited the amylase activity of all tested fungi viz., *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Curvularia pellecense*, *Fusarium equiseti*, *Fusarium oxysporum*, *Macrophomina phaseolina*, *Penicillium digitatum*, *Penicillium chrysogenum* and *Rhizopus stolonifer*. *Acacia chundra* gum inhibited the amylase production of *Alternaria alternata*, *Aspergillus niger*, *Fusarium equiseti*, *Macrophomina phaseolina*, *Penicillium digitatum*, *Penicillium chrysogenum* and *Rhizopus stolonifer*. While it induced the same of *Curvularia pellecense* and *Fusarium oxysporum*. Gum of *Azadirachta indica* increased the amylase action of *Alternaria alternata*, *Aspergillus niger*, *Curvularia lunata*, *Curvularia pellecense*, *Fusarium oxysporum*, *Penicillium digitatum* and *Penicillium chrysogenum*. Whereas, it retarded the amylase production of *Curvularia pellecense* and *Rhizopus stolonifer*.

Amylase production of *Alternaria alternata*, *Curvularia lunata*, *Penicillium digitatum*, *Penicillium chrysogenum* and *Rhizopus stolonifer* increased by *Boswellia serrata* gum while that of *Fusarium equiseti*, *Fusarium oxysporum* and *Macrophomina phaseolina* was retarded by *Boswellia serrata*. *Butea monosperma* gum activated the amylase producing all tested fungi except *Macrophomina phaseolina*.

Amylase production of *Alternaria alternata*, *Curvularia lunata*, *Fusarium equiseti*, *Fusarium oxysporum* and *Macrophomina phaseolina* was retarded by *Cassine albens* gum. *Mangifera indica* and *Moringa oleifera* gum decreased the amylase activity of *Alternaria alternata*,

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Aspergillus niger, Curvularia lunata, Curvularia pellecense, Fusarium equiseti, Fusarium oxysporum and Macrophomina phaseolina. While Sterculia urens gum induced the activity of all fungi except Fusarium oxysporum and Macrophomina phaseolina. Amylase production of all tested fungi was retarded by Terminalia arjuna.

2) **Effect of gum on cellulase activity**

Impact of gum on cellulase activity of fungi was studied and results are given in table 30 and plate 10.

It was found that Acacia arabica gum increased cellulase activity of Alternaria alternata, Macrophomina phaseolina and Curvularia pellecense. While inhibited the same of Fusarium equiseti, Penicillium digitatum and Rhizopus stolonifer. Cellulase action of Aspergillus niger, Fusarium equiseti, Fusarium oxysporum and Rhizopus stolonifer was retarded by Acacia chundra gum whereas cellulase production of Alternaria alternata, Curvularia lunata, Curvularia pellecense and Penicillium chrysogenum, was induced by Acacia chundra gum. Azadirachta indica gum inhibited the cellulase action of Aspergillus niger, Fusarium equiseti, Macrophomina phaseolina, Penicillium digitatum, and Rhizopus stolonifer. Boswellia serrata gum induced cellulase production of Alternaria alternata, Aspergillus niger and Curvularia lunata. While it hampered the same of Macrophomina phaseolina, Penicillium digitatum, Penicillium chrysogenum and Rhizopus stolonifer. Cellulase action of Curvularia lunata, Curvularia pellecense, Penicillium digitatum and Rhizopus
stolonifer was retarded by Butea monosperma gum while that of Alternaria alternata and Macrophomina phaseolina was induced by it. Gum of Cassine albens increased the cellulase action of Alternaria alternata, Aspergillus niger, Curvularia lunata and Macrophomina phaseolina, while it inhibited the cellulase production of Fusarium oxysporum, Penicillium digitatum, Penicillium chrysogenum and Rhizopus stolonifer. Cellulase activity of Alternaria alternata and Curvularia lunata was induced by gum of Mangifera indica. Whereas cellulase production of Aspergillus niger, Fusarium equiseti, Penicillium digitatum and Rhizopus stolonifer was retarded by it. Moringa oleifera gum induced the cellulase action of Alternaria alternata, Aspergillus niger, Curvularia lunata, Macrophomina phaseolina and Penicillium chrysogenum, but it hampered the same of Curvularia pellecence, Fusarium equiseti, Fusarium oxysporum, Penicillium digitatum and Rhizopus stolonifer. Cellulase production of Alternaria alternata and Penicillium chrysogenum was increased by Sterculia urens gum whereas it retarded the same of Curvularia pellecence, Fusarium oxysporum, Penicillium digitatum and Rhizopus stolonifer. Terminalia arjuna gum decreased the cellulase activity of Fusarium equiseti and Penicillium digitatum while it increased the same of Alternaria alternata, Aspergillus niger and Curvularia lunata.

3) Effect of gum on pectinase activity

Effect of gum on pectinase activity of fungi was studied and results are given in table 31. It was found that Acacia arabica gum inhibited the
pectinase activity of tested fungi viz., *Alternaria alternata, Curvularia lunata, Macrophomina phaseolina, Penicillium chrysogenum* and *Rhizopus stolonifer*. The *Acacia chundra* and *Azadirachta indica* gum decreased the pectinase activity of *Curvularia lunata, Curvularia pellecence, Penicillium digitatum* and *Penicillium chrysogenum* and induced *Alternaria alternata, Aspergillus niger, Fusarium equiseti, Fusarium oxysporum, Macrophomina phaseolina* and *Rhizopus stolonifer*.

Pectinase activity was increased by *Boswellia serrata* gum viz., *Alternaria alternata, Curvularia pellecence, Fusarium equiseti, Fusarium oxysporum, Macrophomina phaseolina*, while that of *Curvularia lunata, Penicillium digitatum, Penicillium chrysogenum* and *Rhizopus stolonifer* was retarded.

*Butea monosperma* gum inhibited the activity of *Curvularia lunata, Penicillium chrysogenum* and *Rhizopus stolonifer*, while it was increased in the *Alternaria alternata, Aspergillus niger, Curvularia pellecence, Fusarium equiseti, Fusarium oxysporum, Macrophomina phaseolina* and *Penicillium digitatum*.

The gum of *Cassine albens* induced tested fungi like *Aspergillus niger, Curvularia pellecence, Fusarium equiseti, Fusarium oxysporum, Macrophomina phaseolina* and *Rhizopus stolonifer* and retarded viz., *Alternaria alternata, Curvularia lunata, Penicillium digitatum* and *Penicillium chrysogenum*. *Mangifera indica* gum decreased the pectinase activity of *Alternaria alternata, Fusarium oxysporum, Macrophomina*
phaseolina and induced Aspergillus niger, Curvularia lunata, Curvularia pellecence, Fusarium equiseti, Penicillium digitatum, Penicillium chrysogenum and Rhizopus stolonifer.

Moringa oleifera gum inhibited the pectinase production of Macrophomina phaseolina, Penicillium digitatum, Penicillium chrysogenum, Rhizopus stolonifer and increased the pectinase activity of Alternaria alternata, Aspergillus niger, Curvularia lunata, Curvularia pellecence, Fusarium equiseti and Fusarium oxysporum.

Sterculia urens gum retarded the pectinase action of Aspergillus niger and Penicillium chrysogenum and remaining all test fungi induced the pectinase activity. The Terminalia arjuna inhibit the growth of Curvularia pellecence, Fusarium oxysporum, Penicillium digitatum and Penicillium chrysogenum. The same of Alternaria alternata, Aspergillus niger, Curvularia lunata, Fusarium equiseti, Macrophomina phaseolina and Rhizopus stolonifer where induced.
PART – III

A) Effect of different time period of gum on seed germination:

The impact of different time period of 1% gum concentration of all selected ten plants were studied on the germination of cereals, pulses and oil seeds like wheat, jowar, cowpea, gram, safflower, soybean and the results are summarized in table 32 to 41.

1) Effect of *Acacia arabica* gum on seed germination

It is clear from the table 32 that 1% concentration of *Acacia arabica* gum was found to promote the germination of wheat, jowar, cowpea and soybean at 10 hour treatment. 1 hour treatment was found to promote the germination of wheat, cowpea, safflower and soybean. It was also found to promote the shoot length, root length of wheat, cowpea, gram whereas it was found to retard the growth of shoot and root length of jowar and soybean. Similar type of results were recorded for 3 hour 5 hour treatment.

Whereas at 10 hour treatment the shoot and root length of all treated seeds except jowar were found to be increased as compared to control.

2) Effect of *Acacia chundra* gum on seed germination

In table 33 the result of 1% concentration of *Acacia chundra* gum on seed germination. The percent seed germination of wheat, jowar, cowpea, gram and soybean were found to be increased. The shoot length and root length of wheat, jowar, cowpea and soybean were found to be increased. The % concentration of gum did not affect % germination of soybean. Near
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about similar type of results were recorded for 3 hour, 5 hour, 10 hour treatment.

3) **Effect of *Azadirachta indica* gum on seed germination**

The effect of gum of *Azadirachta indica* on seed germination was studied and results are summarised in table 34 and plate 11. It was found that 1% concentration of gum promote the germination of wheat and jowar at 10 hour treatment.

1 hour treatment was also found to promote the germination of all seeds. It was also found to promote the shoot and root length of wheat, jowar, cowpea, gram. Germination of safflower and soybean seeds was found to be unaffected. Similar types of results were recorded for 3 hour, 5 hour and treatment. Whereas at 10 hour treatment the shoot and root length of all treated seeds were found to be increased as compared to control.

4) **Effect of *Boswellia serrata* gum on seed germination**

It is clear from the table 35 that the gum of *Boswellia serrata* at 1% promoted the growth at 1 hour treatment. The percent seed germination of wheat, cowpea and gram was increased. The shoot length and root length of all seeds were found to be increased. The percent germination of soybean was unchanged at 1% concentration. Near about similar type of results were recorded for 3 hour, 5 hour and 10 hour treatment.

5) **Effect of *Butea monosperma* gum on seed germination**

In table 36 the result on impact of 1 % concentration of *Butea monosperma* gum on seed germination are summarized. It is clear from the
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table 36 that upto 1 hour treatment the percent seed germination of wheat, jowar, safflower and soybean were found to be increased. Due to 1% concentration of *Butea monosperma* the shoot length and root length of wheat and jowar were found to be increased. Similar type of results were recorded for 3 hour, 5 hour and 10 hour treatment for percent germination. The shoot and root length of all treated seeds were found to be increased as compared to control for 3, 5 and 10 hour treatment.

6) **Effect of *Cassine albens* gum on seed germination**

The gum *Cassine albens* were tested for percent seed germination in table 37 that 1% concentration of gum was found to promote the percent germination of wheat, jowar and cowpea at 1, 3, 5 and 10 hour treatment. The shoot and root length of all treated seed except gram were found to be increased at 1, 3, 5 and 10 hour treatment as compared to control.

7) **Effect of *Mangifera indica* gum on seed germination**

It is clear from the table 38 that the gum of *Mangifera indica* at 1% concentration was found to promote the growth at 1 hour treatment. The percent seed germination of all seeds except cowpea. The shoot and root length of all seeds except jowar and gram were found to be increased. The percent germination near about similar type of all seeds were at 1% concentration were recorded for 3, 5 and 10 hour treatment. The shoot and root length of jowar cowpea and gram were found to be decreased and wheat safflower and soybean were found to promote the growth at 3, 5 and 10 hour treatment.
8) **Effect of *Moringa oleifera* gum on seed germination**

In table 39 the result of 1% concentration of *Moringa oleifera* gum are summarized. It is clear from the table 39 that 1 hour treatment of the percent seed germination of wheat, jowar cowpea and soybean were found to be increased. The shoot and root length of wheat, cowpea, safflower and soybean were found to be increased. Almost similar type of results were recorded about effect of *Moringa oleifera* gum on seed germination for 3 and 5 hour treatment. Only 10 hour treatment seeds increased their shoot and root length compared to control.

9) **Effect of *Sterculia urens* gum on seed germination**

The gum of *Sterculia urens* were tested for percent seed germination and results are summarized in table 40 that 1% concentration of gum was found to promote the percent germination of gram, safflower and soybean at 1, 3, 5 and 10 hour treatment. The shoot and root length of cowpea, soybean and wheat seeds found to be increased at 1, 3, 5 and 10 hour treatment as compared to control.

10) **Effect of *Terminalia arjuna* gum on seed germination**

It is clear from the table 41 that 1% concentration of *Terminalia arjuna* gum was found to promote the germination of wheat, jowar and gram at 10 hour treatment. 1 hour treatment was also found to promote the germination of jowar, gram and safflower. The 1 hour gum treatment was also found to promote the shoot and root length of jowar, safflower and soybean. The percentage of germination is similar at 3 and 5 hour treatment.
All seeds except cowpea and soybean increased their shoot and root length as compared to control at 3, 5 and 10 hour treatment.

B) **Impact of different concentrations of selected plant gum on incidence of seed mycoflora:**

Impact of different concentration (1%, 2%, 3% and 4%) of select plant gum on incidence of seed mycoflora of cereals (wheat, jowar), pulses (cowpea and gram) and oil seeds (safflower and soybean) were studied and results are summarized in table 42 to 51.

1) **Impact of *Acacia arabica* gum on incidence of seed mycoflora in different crop seeds**

It is clear from the table 42 that 1% *Acacia arabica* gum induces the incidence of fungi like *Fusarium oxysporum*, *Aspergillus flavus*, *Rhizopus stolonifer* and *Alternaria alternata*. In case of cereals as the concentration of gum were increased, the % incidence of above fungi were also increased. In case of pulses the recorded fungi were *Aspergillus niger*, *Fusarium oxysporum*, *Rhizopus stolonifer* and *Alternaria alternata* at 1% concentration treatment of gum. *Rhizopus stolonifer* was the first fungus of which the incidence was recorded 50% followed by *Alternaria alternata* that is 40% as the concentration of gum were also increased. But moderately in case of oil seeds the recorded fungi were *Aspergillus flavus*, *Aspergillus niger*, *Alternaria* spp., *Alternaria alternata* and *Rhizopus stolonifer*. 
2) Impact of *Acacia chundra* gum on incidence of seed mycoflora in different crop seeds

The results of *Acacia chundra* gum are recorded in table 43 and plate 12. 1% concentration of *Acacia chundra* gum was found to inhibit the percent incidence of fungi as compared to control. Though at 1%, 2%, 3% and 4% concentration the incidence of seed borne fungi increased in case of cereals, pulses and oil seeds. The highest incidence was that of *Rhizopus stolonifer* followed by *Aspergillus flavus*, *Alternaria alternata* and *Aspergillus niger*.

3) Impact of *Azadirachta indica* gum on incidence of seed mycoflora in different crop seeds

From table 44 it is observed that seed mycoflora of cereals and pulses were inhibited by 1% *Azadirachta indica* gum. But in case of oil seeds there was slight change at 2%, 3% and 4% concentration. The incidence of seed borne fungi increased for cereals and pulses. The highest incidence of *Aspergillus flavus* at 1% concentration and the lowest incidence of *Alternaria* spp. was recorded as compared to control at 3% concentration.

4) Impact of *Boswellia serrata* gum on incidence of seed mycoflora in different crop seeds

It is clear from table 45 that *Boswellia serrata* gum promote the percent incidence of seed mycoflora of cereals *Fusarium oxysporum* and *Aspergillus flavus* at 1% concentration were occurred. The concentration of
gum were increased the incidence of fungi pulses and oil seeds. The highest incidence was of *Rhizopus stolonifer* followed by *Aspergillus flavus* and *Alternaria alternata* at 1% concentration.

5) **Impact of Butea monosperma gum on incidence of seed mycoflora in different crop seeds**

It is clear from table 46 that percent incidence of *Fusarium oxysporum*, *Aspergillus flavus* on cereals and pulses were inhibited at 2% *Butea monosperma*. But in case of oil seeds there was slight change. The highest incidence was of *Rhizopus stolonifer* followed by *Alternaria alternata* recorded on all seeds at 2% and 3% concentration. The similar type of result recorded on all seeds at 4% concentration.

6) **Impact of Cassine albens gum on incidence of seed mycoflora in different crop seeds**

It is clear from the table 47 that at 1% concentration of *Cassine albens* gum the incidence of *Aspergillus flavus*, *Aspergillus niger*, *Fusarium oxysporum* on cereals and pulses seeds were inhibited. But in case of oil seed the *Aspergillus flavus* followed by *Aspergillus niger* showed their dominance. The highest incidence was of *Rhizopus stolonifer* and lowest incidence was of *Fusarium oxysporum* and *Alternaria* spp. on cereals and oil seeds at 2% and 3% concentration of gum. 4% concentration inhibited the % incidence of all seeds.
7) Impact of *Mangifera indica* gum on incidence of seed mycoflora in different crop seeds

In table 48 showed the impact of *Mangifera indica* gum on incidence of seed mycoflora which was inhibited on cereals, pulses and oil seeds at 1% concentration. But there was increased in percent incidence of seed mycoflora at 2% and 3% and decreased at 4% concentration for cereals and pulses. *Rhizopus stolonifer* followed by *Aspergillus flavus* and *Alternaria alternata* show highest incidence for oilseed at 2%, 3% and 4% concentration.

8) Impact of *Moringa oleifera* gum on incidence of seed mycoflora in different crop seeds

The result of *Moringa oleifera* gum are recorded in table 49. At 1% concentration of *Moringa oleifera* gum was found to inhibited the percent incidence of fungi of cereals and pulses as compared to control. But at 1%, 2%, 3% and 4% concentration, the incidence of seed-borne fungi increased in case of cereals, pulses and oil seeds. The highest incidence was of *Rhizopus stolonifer* followed by *Aspergillus flavus*.

9) Impact of *Sterculia urens* gum on incidence of seed mycoflora in different crop seeds

It is clear from table 50 that 1% *Sterculia urens* gum found to promote the percent incidence of seed mycoflora *Fusarium oxysporum*, *Aspergillus niger* and *Aspergillus flavus* showed their dominance of occurrence. The incidence of oil seeds and pulses found to inhibit
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*Alternaria* spp., *Aspergillus niger* and *Aspergillus flavus* at 2%, 3% and 4% concentration compared to control. The *Rhizopus stolonifer* was also recorded highest percent incidence of seed mycoflora.

10) **Impact of *Terminalia arjuna* gum on incidence of seed mycoflora in different crop seeds**

It is clear from the table 51 that at 1% concentration of *Terminalia arjuna* gum the incidence of fungi like *Fusarium oxysporum*, *Aspergillus flavus*, *Rhizopus stolonifer* and *Alternaria alternata* were recorded. In case of cereals as the concentration of gum were increased the % incidence of fungi were decreased. In case of pulses the recorded fungi were *Aspergillus niger*, *Fusarium oxysporum*, *Rhizopus stolonifer* and *Alternaria alternata* at 1% gum. *Rhizopus stolonifer* was the first fungi of which the incidence were recorded 50% followed by *Alternaria alternata* 40%. As the concentration of gum were increased the incidence of fungi were also recorded. But moderately in case of oil seeds the recorded fungi were *Aspergillus flavus*, *Aspergillus niger*, *Alternaria alternata*, *Alternaria* spp. and *Rhizopus stolonifer*. The similar type of results like cereals and pulses were recorded in the oil seeds.

C) **Bioassay of gum against economically important insect**

1) **Bioassay of plant gum against *Plutella xylostella***

Bioassay of gum against *Plutella xylostella* at different concentration was carried out and the result were summarized in table 52 and plate 13 & 14. The *Plutella xylostella* showed 0% mortality at all concentrations (like
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1%, 5%, 10%, 15% and 20 %) of Acacia arabica, Acacia chundra and Cassine albens.

At 20% concentration of Azadirachta indica, Butea monosperma, Mangifera indica, Moringa oleifera, Sterculia urens and Terminalia arjuna highest mortality as compared other concentration. At 15 % concentration of Azadirachta indica and Sterculia urens showed 20 % mortality of Plutella xylostella insects. The gum of Azadirachta indica and Sterculia urens showed minimum mortality at 1%, 5% and 10 % concentration of gum.

2) Bioassay of plant gum against Leucinoides orbonalis

In table 53 and plate 13 & 14 bioassay against Leucinoides orbonalis summarized which showed 0% mortality of all concentration of Acacia arabica, Acacia chundra and Mangifera indica gum. 20% concentration of Azadirachta indica showed highest mortality and Butea monosperma Cassine albens, Moringa oleifera showed minimum mortality at 1%, 5% and 10% concentrations.

3) Bioassay of plant gum against Spodoptera litura

Bioassay of gum against Spodoptera litura at different concentrations carried out and the results summarized in table 54 and plate 13 & 14. 0% mortality of all concentrations of Acacia arabica, Acacia chundra and Moringa oleifera, 20% concentration of Azadirachta indica, Boswellia serrata, Butea monosperma showed highest mortality. On the
other hand *Cassine albens*, *Sterculia urens* and *Terminalia arjuna* showed minimum mortality at 20% concentration.

4) **Bioassay of plant gum against *Helicoverpa armigera***

It is clear from the table 55 and plate 13 & 14 that 0% mortality of all concentrations of *Acacia arabica*, *Acacia chundra*, *Mangifera indica* and *Moringa oleifera* gum was observed. At 20% and 15% concentrations of *Azadirachta indica*, *Butea monosperma* and *Cassine albens* highest mortality was recorded.