MEDICINAL PLANTS RESOURCE SCIENCE

for 5th year students 22 Public health 226 «Pharmacy, industrial pharmacy», educational program «Pharmacy»

Фс15(5,0д)English 1-5 groups

**23.03 - 27.03 – Topic: Estimation of the resources amount of medicinal plant material on certain brushwood using methods of registration plots, model specimens and projecting covering**

**CLASS**

**Theoretical material**

**Aim**: learn to identify the brushwood area of medicinal plants; determine the productivity (density of raw material reserve) of medicinal plants; determine the medicinal raw material reserves using methods of registration plots, model specimens and projecting cover.

**Actuality**: The collection of medicinal plants from wild populations can give rise to additional concerns related to global, regional and/or local over-harvesting, and protection of endangered species.

***Theoretical part:***

**Information**

The main indices for resource calculation are two values – the brushwood area and its productivity.

**Determination of the medicinal plants’ brushwood area**

The brushwood area is determined by equating its contours to any geometrical figure (rectangle, square, circle etc.). The parameters which are needed for the calculation of this figure’s area (width, length, diameter etc.) are then determined. The distance can be measured in steps, or in steppe area – using speedometer.

In cases when populations of the studied species grow irregularly forming separate spots within the plant group (e.g. lily-of-the-valley in the herbal cover of a pine forest), the area of the whole forest where lily-of-the-valley grows is determined, and then – the percentage of the area covered with lily-of-the-valley plants.

**Determination of the medicinal plants’ productivity in certain brushwood**

**Productivity -** amount of medicinal plant material, collected from 1m2 of the population area. The real productivity considerably varies in different brushwood and depends on different factors, e.g. it may change from year to year. Therefore the determination of this index is desirable when monitoring. For planning the harvesting of plant material the results of calculation are defined more precisely every 5 years.

The productivity can be determined in several ways. The choice of the method depends on the life form of the plant, its morphological features and the type of the harvested plant material. For small herbaceous and shrubby plants from which aerial parts are collected (lily-of-the-valley leaf and herb, immortelle flowers, St. John’s wort herb etc.) the *method of registration plots* is the most acceptable because of its accuracy in this case.

At the productivity estimation of underground parts or in case of big plants for which the registration plots must be large the *method of model specimens* is used.

For low herbaceous plants in the brushwood of which it’s hard to define the borders of certain specimens (bearberry, cranberry, thyme) the productivity is determined using the *method of projecting cover*.

**Determination of the productivity of medicinal plant material using the method of registration plots**

A **registration plot** is an area of a certain size (from 0.25 m2 to 10 m2), laid within a brushwood or a massif for the determination of the plant material weight, the number of plants or projecting cover.

Registration plots are placed regularly at some distance in order to possibly cover the whole industrial massif (brushwood). They can be placed parallel or perpendicular, diagonally or in the form of envelope. The plots should be laid in a certain number of steps or meters 3, 5, 10, 20) independently from the presence or absence of the specimen of the studied species at this place. The plots must not be laid taking in account subjective considerations choosing “the most typical places” for them.

The number of registration plots should be sufficient for the relative error to be not higher than 15% from the arithmetical mean at the statistical calculation. To receive the precision needed the necessary number of plots depends mainly on the even of the studied species distribution within the group and to a lesser extent - on its abundance. The more evenly the species is distributed the less amount of registration plots is needed. In optimal cases, sufficient accuracy can be reached at laying 15 plots, but in the majority of cases 25 – 30 plots are needed to be laid.

The required number of plots can be defined more precisely by simple calculations:

|  |  |
| --- | --- |
| n =  | ν2 |
| p2 |

where n – necessary amount of plots; p – necessary precision (usually 15%); ν – variation coefficient which is found from the formula:

|  |  |
| --- | --- |
| ν =  | 100σ |
| M |

where M - the arithmetical mean; σ – the average deviation which is calculated from:

σ = ak,

where a - difference between the maximum and minimum values of measured characteristics; k - coefficient depending on the number of laid plots (sample size).

The coefficients depending on the sample size are presented further (Snedecor, 1961):

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***n*** | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| ***k*** | 0,886 | 0,591 | 0,486 | 0,430 | 0,395 | 0,370 | 0,351 | 0,337 | 0,325 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***n*** | 12 | 14 | 16 | 18 | 20 | 30 | 40 | 50 |
| ***k*** | 0,307 | 0,294 | 0,283 | 0,275 | 0,268 | 0,245 | 0,231 | 0,222 |

The size of plots is determined depending on the size of the adult specimens of the studied species. The sufficient size of plots can be considered the one which contains not less than 3 such specimens. The higher the number of registration plots is, the more accurate is the result of the determination of medicinal plant material productivity. Therefore, the higher amount of small registration plots gives more precise results than the fewer of large ones at the same labour-intensiveness.

The plots for herbaceous and shrubby plants are usually from 0.25 to 4 m2 large. The form of the plots (rectangular, square, round) doesn’t matter. The difference in the data is within the experiment error.

After laying the registration plots, all the plant material phytomass is gathered from each of them according to the rules of collection and drying of the certain species. The shoots, juvenile and damaged specimens are not collected. The raw plant material collected from each ground is weighed with the precision of ± 5% as higher precision is labour-intensive and pointless. It is more convenient to use weightless balance when weighing plant material which saves much time.

The approximate data about the necessary number of plots can be obtained by the difference between the minimal and maximal plant material mass. Thus, if there are 15 plots laid and the difference between minimal and maximal weight is not higher than 5 – 7 times, this number of plots is enough. If the weight differs in 15 – 20 times, then 15 – 20 more plots are needed.

The samples needed for chemical taxation of the brushwood can be collected from the plant material gathered from the registration plots.

**Determination of the productivity of medicinal plant material using the method of model specimens**

Two indices are estimated at determination of productivity with the method of model specimens – the number of commercial samples or shoots per area unit and the average weight of plant material from one commercial sample (shoot).

When using this method a model specimen (e.g. a specimen of male fern) or a shoot (e.g. a hawthorn or a wild rose shoot) can be considered a calculation unit. Individual specimens are used in cases when they are relatively small and their boundaries are easily determined. A shoot is convenient to use as a calculation unit in cases when the boundaries of the specimen are hardly determined (raspberry), or individual specimens considerably vary in the development phases (wild rose) or when the collection of the plant material from the whole specimen is labour-intensive (hawthorn).

The number of specimens is calculated depending on the brushwood thickness: a) with considerable thickness of brushwood – on the plots from 0.25 to 10 m2 large (more than 3 – 4 specimens per 1 m2); b) with smaller quantities of specimens – on the transect segments – strips 1 or 2 m long, which are laid along the route passages.

When working on the route passages they should be divided into segments of 20, 50 and 100 steps depending on the size and thickness of brushwood (the bigger the brushwood is and the rarer the species is found the larger the segments should be).

For dominating plants of the grassland at their regular distribution laying of 15 – 20 plots is usually enough, when at their lower abundance and irregular distribution 30 – 50 plots are needed.

To determine the raw material mass the model specimens are collected at the registration plots or transects. All commercial samples are collected without subjective opinion of “typical samples”. The most objective way to receive reliable results is to consider each second, fifth or tenth specimen found on the route passage as a model specimen.

To determine the mass of underground parts of plants is usually enough to collect plant material from 40 – 60 specimens. As vegetative aerial parts vary greatly the number of specimens (shoots) should be increased up to 100 or even more. In case when specimens vary significantly in the development stage it is possible to divide them into 2 – 3 groups which differ from each other in one sign, e.g. with one or two shoots (leaves) and more shoots (leaves). The number of samples in the excerpt that reliably describe the mass of plant material is determined by the scheme described for the determination of the number of registration plots (see above).

The raw material from each specimen is weighed and the mean (M ± m) of this index, or the mass of a model specimen, is then determined. Weighing all the specimens altogether and then calculating the mean by dividing the general mass into the number of specimens is forbidden as such method excludes the possibility of statistical processing of the obtained data. Only in cases of determination the reserve of fruits and flowers the mean weight of a single sample can be calculated as a result of tenfold weighing of 100 specimens. But this method is less precise. Just like in the case of the registration plots method, in the method of model specimens only newly collected plant material can be used.

The productivity is determined by multiplying the number of specimens from an area unit to the mean weight of plant material from one model specimen.

**Determination of the productivity of medicinal plant material using the method of projecting cover**

**Projecting cover** is the projection of aerial parts of the plants on the ground. The estimation of the projecting cover is necessary not only to determine the productivity but also for the general description of the brushwood. In this case the projecting cover is estimated by less labour-intensive and precise methods (visual measurement and Ramensky net). Visual measurement can be used only by experienced investigators after long-term training. For the determination of productivity by the method of projecting cover only quadrat-net can be used which provides more precise results. Quadrat-net is a wiry square with the sides of 1 m, and divided into 100 equal squares with the area of 1 dm2. The quadrat-net is put over the brushwood 15 – 25 times during the estimation. The quadrat-net lets determine the projecting cover of the species (how many cells of the quadrat-net are occupied by the plant) and the yield of plant material from one percent of the projecting cover (division value of one percent).



**The determination of projecting cover with the quadrat-net.**

To determine the division value of one percent of cover at each ground the plant material from each square decimeter of area is cut and weighed and then the mean is calculated (M ± m). The fact that this value varies depending on the different ecological conditions must be taken and thus the division value of one percent of projecting cover must be estimated for new brushwood. The productivity is calculated by multiplying the mean projecting cover to the division value of one percent.

**Estimation of the plant material reserve using the method of key plots**

A **key area** is an area of certain territory which is a standard of the plant material reserve. The data can be extrapolated to the whole brushwood in general. This method allows determining the plant material reserve at rather large territory (for entire administrative and natural geographic units). These may be areas we feel are representative of a larger area (such as a pasture) or critical areas (such as sites where endangered species occur). The method is not used when the aim of the work is the organization of plant material collection at relatively small areas (within the region or forestry).

This method is objective only for medicinal plants which have affinity with certain relief elements, territories, soils and also dominate in grassland and change their productivity little from year to year, for example, calamus, Labrador tea, bearberry, blackberry, cranberry etc.

The number of plots should be large enough to obtain statistically reliable data. The size of key plots depends on the plant cover – the more irregular it is, the larger they are. The area of key plots may vary from one to several square kilometers.

This method requires usage of large-scale maps and plans – soil, geobotanical, topographic, where the relief elements and types of plant communities are indicated. The areas of the territories where the studied plants grow are calculated with the help of such maps.

*Values from different key areas should never be averaged*, because this gives the impression that we have sampled a much larger area than is really the case and because this practice results in a “mean” value for which we can have no measure of precision.

The use of the key plots method requires a high qualified and skilled specialist.

***Література для підготовки до занять***:

1. Medicinal plants resource science : handbook for higher school students / V.S. Kyslychenko, L.V. Upyr, I. G. Zinchenko, O.A. Kyslychenko, S.I. Stepanova; ed. by V.S. Kyslychenko. – Kharkiv: NUPh : Golden Pages, 2012. – 168 p.
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4. Зайцев Г.Н. Математика в єкспериментальной ботанике. – М.: Наука, 1990. – 296 с.
5. Ивашин Д.С., Катина З.Ф., Рыбачук И.З., Бутенко Л.Т., Иванов В.С., Никольская Л.С. Справочник по заготовкам лекарственных растений. – Киев: Урожай, 1983. – С. 53-54
6. Крылова И.Л., Капорова В.И. Составление расчетных таблиц для оценки урожайности лекарственных растений по проективному покрытию // Растит. ресурсы. – 1992. – 28, вып. 3. – С. 141-157
7. Мінарченко В.М., Мінарченко О.М. Методика обліку рослинних ресурсів. Київ:ПП Вірлен 2004. – 40 с.