the analysis of the dynamic properties with Soil moisture and temperature and the nutrient released period from controlled Compound fertilizer

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[Key words]:soil moisture **;**soil temperature;the Rosin Glycerin Ester coated Compound fertilizer;imitation;

[Abstract]: This text studies coated material as the Rosin Glycerin Ester and preparation the coated -released-fertilizer, Studying the effects of soil moisture and temperature on nutrient release of coated compound fertilizer.

The result shows that the temperature and soil moisture content have great influence on the total dissolution rate of rosin glyceride coated compound fertilizer; the rate of nutrient released increase with increased 0f temperature and the rate of nutrient releasedincreased with increased of rate 0f soil moisture and soil temperature ,the accumulated nutrient released increased with increased 0f rate 0f soil moistureand soil temperature; There was obvious relation of line type with nutrient released period (d) and rate 0f soil moisture (w). d =287.8-3.53 w， r=0.99and that of rate 0f soil temperature(t) d =209.6-13t, r=0.97.

The active groups of Natural Rosin are hydroxyl and conjugated double bonds, preparation of the Rosin Glycerin Ester using the Esterification of Zinc Oxinde and glycerol, Natural Rosin also has water resistance, etc[1].

Coated Fertilizer, also know as controlled release fertilizer, common film forming material has resin, polyethylene, paraffin wax,etc[2]. The rate release of fertilizer nutrient depended on the type、dosage、the solubility of fertilizer、soil temperature and water content, and the content of microbial activity in soil, etc[3]. At present, the utilization rate of chemical fertilizer was low[4]. Due to the coated fertilizer nutrient release and crop demand for synchronization. At the same time, it has less volatilization and less leaching, so it has become a hot issue in the field of fertilizer.

Fromtheexistingresearchresultsofview[5], the rate of nutrient released of coated fertilizer was measured in pure water environment, the result was not equal to the nutrient dissolution rate in soil[6].Therefore,key issues in this paper washow to consider the soil moisture and temperature, coated materials ,fertilizer factors and according to the change of soil moisture content and temperature, studied on effect on coated fertilizer on nutrient release.

In this paper, by the coated compound fertilizer of the Rosin Glycerin Ester was coated material as raw material, setting different soil moisture content, soil temperature, throughpotexperiment,determination of nutrient content in coated fertilizer by mass determination, The effects of soil moisture and temperature on Kinetic characteristics of nutrient release from the

Rosin Glycerin Ester coated compound fertilizer were studied,the purpose of this study was to provide scientific basis for the development and utilization of the Rosin Glycerin Estercoated compound fertilizer.

Materials and methods

Material

The Rosin Glycerin Ester:self-restraint;

The compound fertilizer: Kunming Jin Xun Chemical Co., Ltd. Production, nitrogen、phosphorus、potassium total nutrient≥46.0%.

Weighing quantitative compound fertilizer (Mo)and weigh the coated compound fertilizer (M).

The rate of coating coverage of coated compound fertilizer $C=（M—Mo）/M$，C=8%

Method

Set upsoil moisture and soil temperature

The tested soil was a red loam soil outside the campus of Kunming University of Science and technology, each pot was filled with soil 5kg and to be measured the coated compound fertilizer was placed in each basin. Take different soil samples, drying at 105°C degrees, Determination of soil moisture content (gravimetric moisture content); in different test greenhouse (artificial temperature control), control the soil temperature change.

Determination of the rate of nutrient dissolution onthe Rosin Glycerin Ester coated compound fertilizer

Hard plastic bucket with upper diameter 45cm, lower diameter 24cm, high 30cm, the 1g coated compound fertilizer mixed with 5g red soil, and wrapped with nylon net, were placed in different positions under the soil 15cm, make contact with the soil as much as possible.

The dissolution rate of nutrients was determined by the method of quality, the quality of the fertilizer contained in each basin was measured every 3 days (the Rosin Glycerin Ester coated compound fertilizer and soil separation), then convert the effective component content, the rate of cumulative dissolution was calculated.

The rate of cumulative dissolution[6] = n (d) Dissolved nutrient quality/ The total quality of nutrients in fertilizers×100% n---- day d

Type of test variable settings

Soil moisture content: 20%、24%、27%、30%、33%、35% test soil, Keep soil temperature 24°C，the greenhouse temperature is set at 15°C、18°C、21°C、24°C、27 °C and 30°C， pot temperature experiments were conducted to keep soil moisture content 27%. During the experiment, the soil moisture content and temperature remained unchanged.

Table 1. the determination of scheme of rate of nutrient released

Handle	Variable settings		Value range					
1	Soilmoisture content	%	20	24	27	30	33	35
2			15	18	21	24	27	30
	soil temperature °C							

Results and analysis

Effect of the dynamic characteristics of rate of nutrient accumulation on coated compound fertilizer with soil water content

Visible from Figure 1, Within 0 to 34 d, When the soil moisture content was 35%, the rate of total nutrient released on coated compound fertilizer was the highest, while the soil moisture content was

20%, and that was low. The rate of nutrientcumulative dissolution on coated compound fertilizer decreased in 4d, the reasons were as follows: with the increase of coated compound fertilizer absorbing soil moisture, the weight of coated compound fertilizer increased. According to the formula of cumulative dissolution rate, the rate of nutrientcumulative dissolution curve showed a downward trend.

The trends was: the rate of cumulative dissolution on coated compound fertilizer increased at 1d, and that decreased to the lowest point in the 4d, and that increased after the first 5d, that the speed was slow, with13d later, the rate of nutrient released was faster, the change curve showed V type, nutrient released can be divided into 3 stages:

• The rapid released stage, due to the defects of the fertilizer coating, out of proportion withsoil moisture content.

, The slow released stage, that was related to soil water content, the higher the water content,the greater the soil moisture gradient, the smaller the nutrient released, the lower the curve.

f The rapid release stage, the higher the soil water content, the greater the of nutrient dissolution , the greater the amount of released, the curve shift, this conclusion was basically the same as the results of Jiao xiao guang[7].

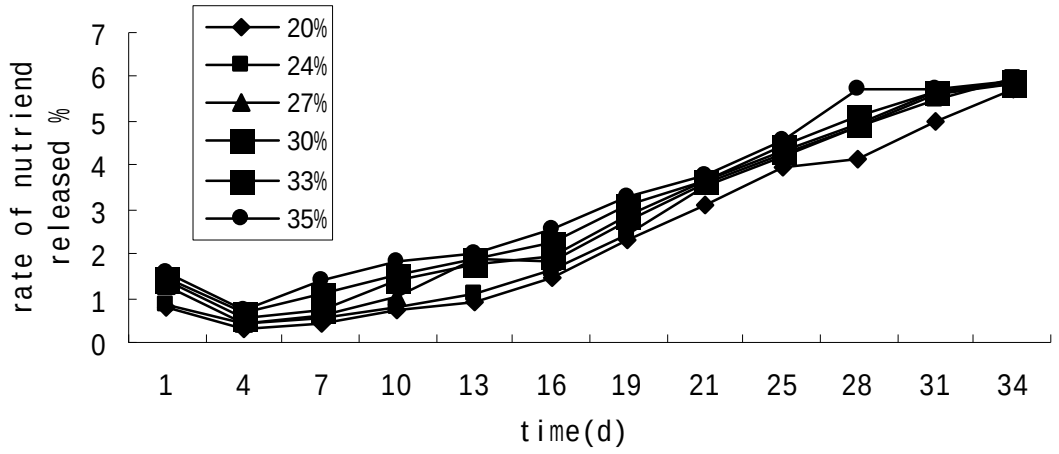

Fig 1.The curves of accumulated nutrient released from coated released compound fertilize on different rate of soil moisture

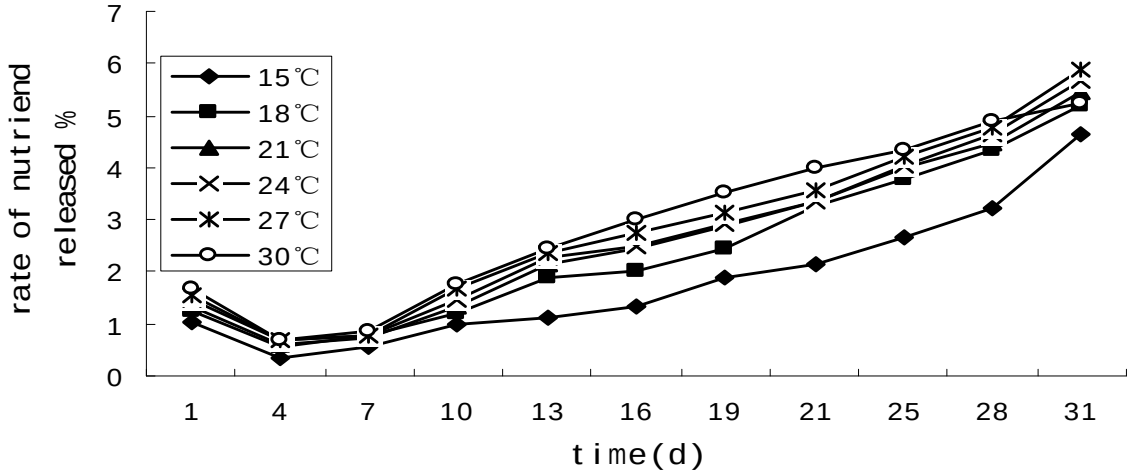

Fig 2.The curves of accumulated nutrient released from coated released compound fertilize on different rate of soil moisture

Effect of the dynamic characteristics of rate of nutrient accumulation on coated compound fertilizer with soil temperature

Visible from Figure 2, the same coating coverage on the Rosin Glycerin Ester coated compound fertilizer，at the temperature of 25°C, in the first 13 days, the cumulative dissolution rate curve of the Rosin Glycerin Ester coated compound fertilizer was small, in the 13 to 31d, the rate of dissolution changed greatly, that increased from 2.5% to 5.7%; at the temperature of 30°C, the rate of cumulative dissolution increased from 0.78% to about 5.56% for the Rosin Glycerin Ester coated compound fertilizer from day 13 to 31. Therefore, with the increase of soil temperature, the rate of cumulative dissolution on the Rosin Glycerin Ester coated compound fertilizer increased. The reasons were as follows: as the soil temperature increases, the molecular motion velocity of nutrients in the fertilizer increases, fertilizer nutrients from high concentration gradient to low concentration gradient motion transmissibility accelerate, nutrient released into rapid released stage, this conclusion is basically the same as the results of Tremble M E so on[8].

The mathematical modeling of soil moisture content and nutrient released period of coated compound fertilizer

The nutrient release of coated compound fertilizer depends on the total content of nutrients in the fertilizer, the rate of nutrient released on coated compound fertilizer was related to the soil moisture content and other environmental factors. In the measurement period, with the extension of time, the rate of nutrient release on coated compound fertilizer was different, it reflects that the curve was exponential. Therefore, the LOGISTIC function was used to simulate [9].

$$N=N_O[1-\exp(-kt)] \text{ ----------（1）}$$

N---t rate of released with time %，N_O--- rate of maximum released %，k--- Release rate constant gd^{-1}，t--- was time（d）。

In the simulation, coated compound fertilizer with different soil moisture content, assumed that the N_O was 100%, then according to Fig. 1 measured data fitting equation (1) of the K value, take the average of 5 times, the daily released rate constant of the coated compound fertilizer. According to formula (1), the T value of nutrient release period of coated compound fertilizer was calculated by using the daily released rate constant of coated compound fertilizer.

From table 2, the rate of released constant of coated compound fertilizer increased with the increase of soil temperature, and thenutrient released period of coated compound fertilizer decreased with the increase of soil temperature.

To quantitatively analyze the relationship between nutrient released period and soil moisture content of coated compound fertilizer, the mathematical model of envelope compound fertilizer nutrient released period and soil moisture content curve was established.

According to figure 2, it can be seen that the curve of nutrient released period (d) and soil moisture content (w) of coated compound fertilizer was linear after 4d. According to the regression analysis method, A=287.6， B=-3.43 r=0.99, according to the correlation test to reach the pole correlation level.

so $d = 287.6 - 3.43\,w$ -------（2）

Table 2. Fitted parameters ofnutrient released period (d) and soil moisture

water content %	No %	K g/d	d Nutrient release period	r correlation coefficient
20	100	0.021	219	0.970
24	100	0.022	211	0.980
27	100	0.024	192	0.097
30	100	0.025	180	0.098
33	100	0.026	171	0.098
35	100	0.028	164	0.099

The mathematical modeling of soil temperature and nutrient released period of coated compound fertilizer

From table 3, the released rate constant of coated compound fertilizer increased with the increase of soil temperature, and thenutrient released period of coated compound fertilizer decreased with the increase of soil temperature.

Table 3. Fitted parameters ofnutrient released period (d) and soil temperature

℃ temperature	No %	K g/d	dNutrient release period	r correlation coefficient
15	100	0.023	201	0.970
21	100	0.025	180	0.097
24	100	0.027	167	0.098
27	100	0.029	158	0.098
30	100	0.031	147	0.099

In order to quantitatively analyze the relationship between envelope compound fertilizer nutrient released period and soil temperature, the mathematical model of envelope compound fertilizer nutrient release period and soil temperature curve was established. According to figure 2, it can be seen that the curve of nutrient released period (d) and soil temperature (t) of coated compound fertilizer was linear after 4d. According to the regression analysis method, A=209.6, B=-13, r=0.97, according to the correlation test to reach the pole correlation level.

so d =209.6-13t ------（3）

Conclusion

Through the experiment of the rate of total dissolution indoor the Rosin Glycerin Ester compound fertilizer, the effects of 6 kinds of soil moisture content and soil temperature were studied in 5 kinds of soil, the dynamic curve of rate of cumulative dissolution on coated compound fertilizer, the conclusions was as follows:

• The soil moisture and soil temperature is higher, the Rosin Glycerin Ester coated compound fertilizer nutrient cumulative dissolution rate showed a rising trend; the daily release rate of the Rosin Glycerin Ester coated compound fertilizer increased and the nutrient release cycle decreased.

, Nutrient release period of the Rosin Glycerin Ester coated compound fertilizer (d) with soil water content (W)change regulation was d =287.8-3.53 t，r=0.97.

f Nutrient release period of the Rosin Glycerin Ester coated compound fertilizer (d) with soil water content (t)change regulation was d =2209.6-13 w，r=0.99。

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