

Study on the spectral radiometric characteristics and the spectrum yield model of spring wheat in the field of BeiAn city, HeilongJiang province, China (primary report)

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ABSTRACT: Through the measurements and analysis of the growing condition and the yield of grain in 24 sample-sites located in the field of BeiAn city with the spectral radiometers (WFD9), we have got the result that Spring Wheat possesses most distinguishing features of reflective spectrum like those of other green plants, but it has its own special feature. The curves of spring wheat reflection usually change with its different growing stage and has certain rule of change. The reflective data of the ratio between the band 5 and band 7 (MSS) seems to be closely related with the yield by using the method of regression. The results reinforce the potential to us that we can forecast the yield of spring wheat before the harvest with measurements of radiometer.

1. METHODS AND MATERIALS

The field experiment was located on the Black earth in BeiAn city (47°40'N-48°40'N, 126°127' E) Heilong Jiang Province. According to the historical yield of BeiAn city, the field was divided into two levels of yield: the high yield and the mid yield. A Model "WFD9" radiometer with 16 field of view was used to measure radiances corresponding to the Landsat MSS band 4, 5, 6, and 7, representing 0.5-0.6, 0.6-0.7, 0.7-0.8 and 0.8-1.1 μm wavelength, respectively. The reflectances were measured with two radiometers (WFD9) on clear days throughout the growing season of spring wheat. Readings were obtained on 15 days during the growing season. Our original intent was to use the reflectances of spring wheat to establish the spectrumyield model and attempted to estimate the yield of spring wheat with the measurement of spectral radiometer.

2. RESULTS AND DISCUSSION

In table 1, there is no difference in the reflectance tendency of different crops, but in the band 6 or 7, the differences of reflectances are notable, it approached from 13.2% to 41%. see fig.1.

In table 2, the difference of reflectance of the variant growing stage of spring wheat also possesses the same rule. The value of difference in the band 7 approached 7.86% to 19.31%. On figure 2 and 3, we have found the reflectance can be used to monitor the growing strength of spring wheat. The reflectance of plants growing well is higher than that of plants growing badly. The difference in band 7 is very significant. The absorption of sunshine is lesser and its reflection is greater because the chlorophyll content of plants is lesser at seedling and nodal stage. The absorption and reflection of sunshine are stronger and weaker, respectively, because the chlorophyll content of plants is higher from heading stage to milky maturity stage.

The reflective data of the ratio between the band 5 and band 7 seem to be closely related with the yield by using the method of regression. We have obtained the primary spectrumyield modal of spring wheat as follows:

$$Y = -567.27 + 974 X \text{ (high yield spectrumyield model)}$$

$$R = 0.87$$

$$Y = -907.3 + 2485 X \text{ (mid yield spectrumyield model)}$$

$$R = 0.93$$

(note: $X = \log IR/R$)

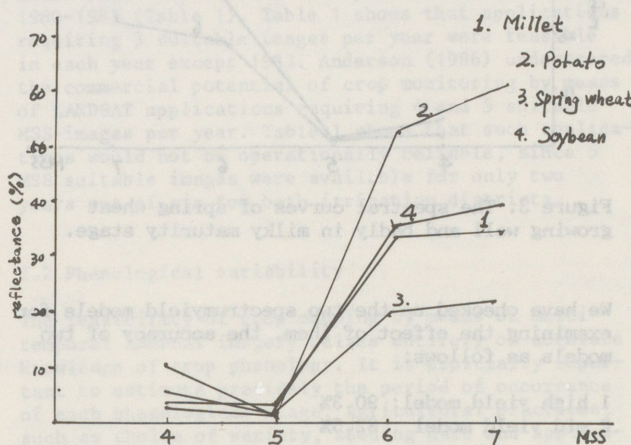


Figure 1. The spectral curves of different crops

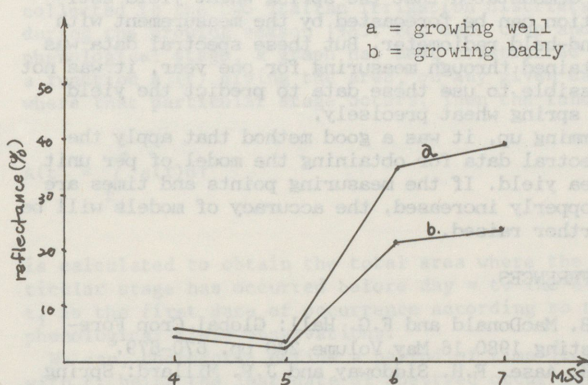


Figure 2. The spectral curves of spring wheat growing well and badly in heading stage.

Table 1. The reflectances of different crops
(1985, July 13, BeiAn city)

Band (MSS)	Millet	Patato	Spring Wheat	Soybean
4	3.5	10.3	2.9	5.7
5	1.0	1.1	1.5	1.7
6	34.1	51.8	18.5	35.6
7	34.6	62.4	21.4	39.3

Table 2. The reflectance of variant growing stage
of Spring wheat (1985 May - July, BeiAn city)

Band (MSS)	Seedling stage	Nodal stage	Heading stage	Milky maturity
4	12.05	9.28	5.85	4.73
5	10.85	5.7	3.1	2.35
6	35.35	39.23	30.72	22.75
7	37.95	45.18	33.73	25.87

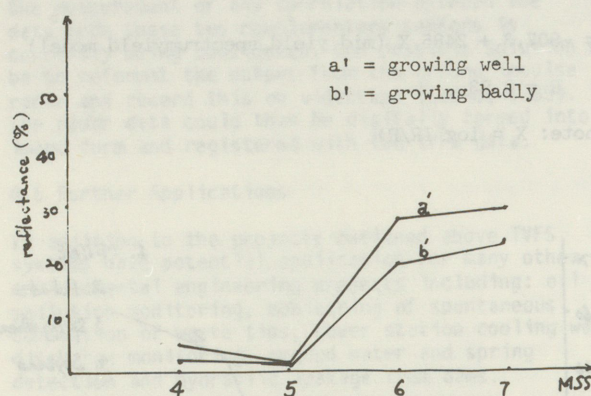


Figure 3. The spectral curves of spring wheat
growing well and badly in milky maturity stage.

We have checked up the two spectrummyield models for
examining the effect of them, the accuracy of two
models as follows:

- 1 high yield model: 90.3%
- 2 mid yield model : 92.5%

3. CONCLUSION

We demonstrated that the spring wheat yield esti-
mation can be forecasted by the measurement with
hand-held radiometer. But these spectral data was
obtained through measuring for one year, it was not
possible to use these data to predict the yield
of spring wheat precisely.
Summing up, it was a good method that apply the
spectral data for obtaining the model of per unit
area yield. If the measuring points and times are
properly increased, the accuracy of models will be
further raised.

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